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TO ADVERTISERS
CHANGES for advertisements should be in this office by Friday noon for the following week's issue.
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A Happy and Prosperous New Year to electricians the world over!

Interest in electrical progress is evidenced by press quotations from various sections of the country, published elsewhere in this issue. The figures we have given, showing the development and evident stability of electrical properties of two important branches, have been widely noted, and leading financial institutions have expressed to us the belief that the success shown assures additional capital for the field of electrical endeavor. It is rapidly becoming recognized, we believe, that no safer investment can be made in these days than in well-organized electrical companies.

ELECTRIC LIGHTING COSTS AND PROFITS.

Elsewhere in this issue there is set forth the result of a study of the cost of fuel and the rates charged for electric current in different parts of the United States. These figures are analyzed in that place, and here it is intended to speak of only one phase of this interesting subject, which is the relation between the price charged and the nature of the goods delivered.

The base rate upon which electric light is sold by meter varies between twenty cents and five cents per kilowatt-hour in different parts of the United States. In a very large majority of stations electric meters have been installed in the premises of customers, and the old contract arrangements, under which electric lighting was first introduced to the public, have been abrogated in favor of the new method of charging for current supply by meter. Apparently nothing could be more equitable; practically, results attained by the meter system and the condition of the art determining the future outlook of electric lighting companies both point to the necessity for some revision of this method of charge if the best results and the greatest satisfaction all round are to be attained.

The difficulty lies in the fact, often pointed out in these columns, that electricity supply companies are selling kilowatt-hours to people who are buying light and power. Unfortunately, the proportion between the kilowatt-hours registered on a meter and the amount of light, or the amount of power, obtained by the customer is not an invariable function. The average purchaser of electric light does not know a volt from an ampere, nor has he the remotest conception of the terms in which his monthly bills are couched. This of itself invites dissatisfaction. In general, the more elaborately complicated and apparently equitable system of charge employed, the more dark and awful a mystery it seems to the man who has to pay the bills, and the more it invites his criticism and dissatisfaction. And in addition to this, no system whereby a man is charged for the raw material which must be converted through more or less variable agencies into the desired product can be either entirely equitable or entirely satisfactory.

It should be borne in mind that the customers of a central station want light or power, and they are willing to pay for these commodities by meter or otherwise, provided they feel that the meter accurately registers their consumption. Herein lies the whole gist of the matter. We must in some way return to the lamp-hour or candle-power-hour basis of charge in order to put the electric light business where it belongs before the public.

Doubtless these remarks will be regarded as heretical, but station managers confronted with the possibility of great improvements in electric lamps must do something. The proposition is simply this: High-efficiency lamps mean the same light for reduced current consumption. If the customer is contented with the same light he will pay the station less for it. It is argued, on the other side, that this cheapening of light will produce a very wide expansion of electric lighting which will more than compensate for the decreased price received by the station per unit of light. It should not be forgotten that this also means an increased capital cost and maintenance cost for mains, conduits, feeders, etc. On the basis of a system of charge of whatever kind that would equitably measure the light or power actually supplied to the customer, the stations themselves will receive the benefit of any improvements in lamps, motors or methods, and this without in any way subjecting the current user to detriment.

The subject is one that should receive

the most careful, thoughtful and immediate attention. It is commended to electric light men as one worthy of the best that they have to give it, and it is hoped that these remarks may produce some discussion which will bring out a better plan than is now generally pursued in the handling of this business.

WIRELESS TELEGRAPHY WORK IN THE UNITED STATES WEATHER BUREAU.

The report of Professor Willis L. Moore, chief of the United States Weather Bureau, contains a large amount of interesting information regarding the work in the development of wireless telegraphy which has been done by that bureau. A number of substantial improvements have been made in the Weather Bureau's system of wireless telegraphy. The efforts of this bureau have been directed toward the solution of three problems, the first of which was to perfect a transmitter which should be more powerful and in which the energy of radiation should be largely increased. Another was to devise a more delicate receiver and one which should not depend upon an imperfect and variable contact as are the systems of the present time. The third was to discover a system of selective telegraphy by which messages could be differentiated, so that only the receiver for which the message was intended should receive them.

Professor Moore reports that the problem to discover a more powerful or economical transmitter has been solved successfully, and he believes that the problem of devising a more delicate receiver is nearing solution. The third problem, that of discovering a system by which the messages could not be interrupted, has been solved theoretically, but not yet fully demonstrated in practice.

A large amount of experimental work remains yet to be done before the system is reliable for intership communication or before any two systems of wireless telegraphy can work within the same field without each rendering the other useless. Such progress has been made that, with no interference by private systems, stations can be operated over a distance of 150 miles. Such stations are now in operation on the coast of North Carolina and Virginia, and stations are soon to be established between the mainland and the Farallone Islands, and also between the mainland on the Pacific coast and the Tatoosh Islands.

In case a system of selective telegraph can not be discovered such as not to render useless other systems and thereby prevent the use to commerce of wireless telegraphy, it may become necessary, because of the value of wireless telegraphy to the marine interests, for the government to take exclusive control of all systems of aerial space telegraphy and to establish stations along the coast where they will not interfere with each other. In this case even difficulty would be experienced occasionally where two ships near together were trying to communicate with one of the stations.

It should be a source of great gratification to all those who are interested in the development of the art of wireless telegraphy that such important advances have been made by this bureau of the government, and all will await with increased anticipation, since Marconi's recent discovery, the developments which the future may bring forth from this direction.

1902.

The new year is a time at which we are rather given to summing up what has gone before and prophesying about what may come in the future. It is doubtful whether the gift of actual prophecy would be either enjoyed or appreciated if anybody had it. We can look in most matters only a very little way, and that dimly, into the future; but we can see, in so far as the electrical industry is regarded, that progress will be swift and advancement sure during the coming year.

The year which has just closed was one of the most remarkable that has marked the history of the advancing electric arts. A number of great inventions were made in it, and most notable works of engineering completed or undertaken. Perhaps no other year since 1876 has seen so much progress as has the last.

We open the new year with the brightest outlook and prospect that has been enjoyed for a long time. Every indication points to a continuance of the prosperous and satisfactory conditions which have marked the last two years. The limit to the expansion of our foreign trade has apparently, in some degree, been reached by the inability of foreign markets to absorb more of our goods, but even with this limitation our industry and commerce are at a high tide of prosperity, and people generally in all walks of life are receiving good incomes. It is an era of expansion and development when capital may easily be had in large sums at low rates of interest for the promotion and establishment of engineering works.

CAPITAL AND LABOR.

A meeting was held in New York last week which would seem to mark a great advancement in the relations of capital and labor. At this meeting men from among the largest employers of labor in the country and also those at the head of some of the largest labor organizations were assembled for the purpose of discussing means of settling harmoniously the great problems which are constantly arising between capital and labor, and if possible do away with the great strikes, the results of which have been so disastrous in their effects both upon capital and upon labor.

As a result of this meeting a standing committee was named to which troubles between capital and labor could be referred and, if possible, a settlement reached without resort to strikes. This committee is composed of representatives on behalf of the public, of organized labor and prominent employers.

The personnel of the committee indicates that much good is to be expected from it in the future, but it should be remembered that to be of any use disputes must be referred to it and that both parties to a dispute must abide by its decisions, and that they must be final. If this is not done, the purpose for which the committee was formed will be completely thwarted and a great opportunity lost to both parties.

Is it not about time for the electric ferryboat to be put into service? It would show high economy over steamboats for short ferriages.

Science Brevities

Electrical Properties of Chromium—The current number of the *Journal* of the Chemical Society abstracts a paper by Mr. Eberhard Brauer, giving the results of a study of the electrical properties of chromium during dissolution in acids. It seems that the dissolution of "active" chromium is attended by a remarkable periodicity in the rate of evolution of hydrogen, while active chromium also exhibits changes in its electric potential as the current produced by a cell of active chromium and platinum immersed in acid periodically varies. The author describes apparatus by which both these variations can be simultaneously studied; a cell of active and inactive chromium in hydrochloric acid was employed, and the variations of hydrogen evolution and of current strength produced oscillations of two reflecting mirrors, whereby two permanent records on photographic paper were obtained in juxtaposition. It was found that the two variations were intimately connected, perfectly analogous curves being obtained for both, although evidence of variations in the electrical properties was obtained when the evolution of hydrogen was apparently constant. The influence of temperature was studied; no periodicity was observed at six degrees, it was very marked at twenty degrees, and an increase to thirty-one degrees caused a great increase in the frequency. The effect of variation of concentration of the acid was also investigated, the frequency was found to increase with concentration, but to be no longer apparent when the acid was too strong. A cell was also employed in which a current of the acid was maintained, so that variations of composition at the electrodes were avoided; in some cases a sufficiently rapid flow of acid caused a cessation of the periodicity. It was found that a piece of pure chromium was inactive, but that activity was induced by rubbing with a piece of cadmium. Slight activity was also occasioned by the addition of sulphides or arsenic to the acid, this addition having further very great influence on the periodicity of active chromium. The author considers that the explanation of these phenomena is to be looked for in the variations of electromotive force associated with the different oxidation stages of chromium.

Resistance of India-Rubber—Mr. A. W. Ashton has made an attempt to ascertain what relation exists between the resistance of different dielectrics and the electromotive force at which the resistance is measured, and also what effect is produced on the insulating properties of india-rubber by the continued application of a high alternating pressure. The results of his work have been published in the *Philosophical Magazine* and abstracted in the London *Electrician*. It appears that Para rubber, which is the kind generally used in the manufacture of cables, is more easily attacked by ozone or other gas generated by the action of alternating stress on the air than other kinds of rubber. This decomposition has, however, only been detected when there has been comparatively free access of air to the rubber. In the case of the rubber called No. 1 by the author, although it was kept for 3,000 hours under an alternating stress having a maximum value of 50,000 volts per cm., no deterioration in insulating properties could be detected, but the fact that this rubber becomes harder and rather brittle on keeping makes it unsuitable for cable work. The principal conclusions arrived at are: That in the case of the okonite cable the current during the first hour's electrification increases as the charging pressure increases; that this does not necessarily prove the dielectric not to follow Ohm's law, since the true conduction current must be considerably less than the total current, unless electrification is continued for very lengthened periods; that in the case of the okonite cable and the paraffin paper condensers, the charging current is a power function of the time reckoned since electrification commenced, and on this may be superimposed a current of true conduction; that for the okonite cable, the mica, and the paraffin paper condensers, the discharging current is a power function of the time which has elapsed since discharge began, the currents at any particular charging pressure, but varying time of charge being given in case of the okonite cable by equations of the form:

$$e = \left(\frac{t}{K_1}\right)^{-x},$$

where $x - X = K_2 T^{-z}$; t = time in seconds since discharge commenced, T = time of charge in seconds, and K, K_1, K_2, K_3 and z are constants.

Improvements in the Goldschmidt Welding Process—In a recent issue of the *Zeitschrift für Elektrochemie*, Dr. H. Goldschmidt, of Essen, describes improvements in welding by his well-known "Thermit" process. This article has been abstracted in the London *Electrician*. In the older form of apparatus it was customary to use a crucible of ordinary shape for containing the "Thermit" mixture, and when the reaction between the aluminum dust and oxide of iron was complete, the liquid contents of the crucible were poured off over its edge, the molten corrundum being the uppermost owing to its lower specific gravity. By this method a certain loss of heat resulted from radiation. Using the new method this loss is avoided, and welding by use of "Thermit" is simplified and increased in efficiency. The new form of "Thermit" crucible is funnel-shaped, and is open below. A lead casing, lined thickly with a basic fire clay, is recommended. The dimensions of the discharging hole are important. It should be tapered from above, measuring 30.66 mm. at its widest point and 8.12 mm. only at its lowest point. The funnel-shaped crucible is supported by a tripod or other means closely above the joint to be welded, and the amount of "Thermit" charged must be regulated by the size of the joint and thickness of metal required. Two methods of tapping this crucible when the reaction between the aluminum and ferric oxide is complete are described. In the first, plates of sheet iron of varying thickness are inserted in the discharging hole at the base of the crucible. The molten iron, as it collects in the bottom of the crucible, melts through these, and the discharge is automatic. It is difficult, however, to select plates of just the requisite thickness to be penetrated at the moment when the reaction is completed, and the separation of the two layers has occurred. It is, therefore, safer to use the second method, which consists in the use of a lever arm and punch working from below, by means of which the plate closing the hole can be pushed away when the contents of the crucible are ready for discharge. A thicker plate, of course, must be used in this case, and it is advisable to cover it with one cm. of fine sand to guard against the danger of premature discharge. Several illustrations are given of welds carried out with the new form of apparatus. It is stated that with it, broken steamship propeller shafts have been satisfactorily joined, as a result of the high temperature of the molten iron at the moment when the reaction between the aluminum and the ferric oxide is completed. This temperature is estimated to be 3,000 degrees centigrade, and with the new apparatus a little loss of heat occurs between the crucible and the welded joint. Such a repair of a broken shaft is said to have been recently carried out with success on a ship owned by Messrs. Lester & Perkins, at the Royal Albert Docks, London.

THE CONSTRUCTION OF SMALL TELEPHONE EXCHANGES.

BY A. E. DOBBS.

SHORT TOLL AND PARTY LINES.

Party lines do not furnish an ideal service; there are quite a number of objections to them. In the first place eavesdropping is probably one of the worst, for there is nearly always some idle individual —sometimes several—connected on the line who wishes to find out what his neighbors are talking about, some farmer's lines being so bad in this regard that if the subscriber called does not answer the first ring, he can not be signaled again till every illicit listener on the line has hung up his receiver, which may delay a call for ten or fifteen minutes.

In the second place, when a subscriber wishes to use his line it frequently happens that some other party is using it at the same time, which is exasperating and often creates hard feeling, especially when two or more subscribers try to obtain possession of the line at the same time, which frequently happens. Many subscribers, very inconsiderate of the rights of others, will hold the line an unreasonable length of time, or neglect to ring off when through using it, thus delaying the disconnection at central. In some cases, however, they are not really to blame, as on a heavily loaded line it is a difficult matter to ring off, as the switchboard drop does not readily fall. Thus party lines do much to emphasize the worst traits in human nature.

Third—When another party in the same neighborhood desires connection the temptation to add one more to an already overloaded line instead of building another line out to that particular community is very strong with some managers. It may be the intention to build another line out there in a few weeks, but this is frequently neglected and the subscribers are compelled to worry along with a very inefficient service.

Some manufacturers in the past have advertised instruments that would signal over thirty or forty stations on one line, but most of them have found out that poor service, which is an almost certain accompaniment to this condition of things, tends to discredit their instruments, and though they sell instruments for heavy work of this kind, they now do all they can to discourage the practice.

Fourth—A party line always takes up as much of an operator's time as two or three connections to a single line, due to the fact that the party called does not often answer promptly, as the constant ringing on the line makes them more or less inattentive to all signals. All this is based on the supposition that selective signaling is not used. If the ringing is done selectively, the switchboard is complicated, an undesirable feature.

Fifth—Selective systems are rather difficult for the average small exchange inspector to understand, and very few of them are so constructed that they can not get out of order; some of them, we regret to say, do so quite frequently.

We sometimes find short toll and party lines combined, which are, if possible, a still greater nuisance. And yet managers of small exchanges are compelled by the necessities of the case to build party lines in a great many places and make them pay, where direct lines would not pay interest on their first cost.

A great many communities would not support expensive construction and are, therefore, content to put up with a comparatively poor service which, in many cases, is the only one that can be afforded. Moreover, in many cases cheap party line service educates a community to the advantages of telephonic communication, and in time leads to a demand for something better.

Even a poor telephone service is better than none at all, and very few people having a telephone fail to get their money's worth.

To illustrate the situation, in a great many rural districts adjoining fairly good sized towns in the central and western states, the manager is confronted with the following conditions:

First—A group of farmers living from five to ten miles from town desire telephone connection.

Second—To build a respectable line of twenty-five-foot poles with, say, one circuit upon it, requires an expenditure of from $75 to $100 per mile, including instruments.

Third—To make this line remunerative requires an income equal to at least twenty per cent on the original investment.

Fourth—To make such a line pay would, therefore, require an income of $100 a year for each five miles of its length.

Fifth—Not anticipating more than ten or twelve subscribers, the line is frequently built as a bracket line and if another line should be added more brackets are put on.

Sixth—It sometimes happens that conditions are such that rural communities will not pay more than from $12 to $18 a year for service which, for the reasons already explained, makes either grounded or ten-party lines necessary—the ten being sometimes increased to twenty parties on one line, to the great detriment of the service.

Seventh—The amount of money in the exchequer is often limited to such an extent that it is difficult to secure the necessary funds to build properly.

To begin with the first condition, a prosperous farming community is a very valuable adjunct to an exchange and greatly increases its value, as does also the operation of widely connected toll lines.

As to the second, the greatest cost of building a small line consists in the setting up of the poles and cross-arms, after which the cost of new circuits is but little greater than that of the wire and instruments. In order to reduce the first cost of building, farmers will, in the winter time, frequently cut and haul poles to the road free of expense to the company, and in some cases even go so far as to furnish the labor necessary to setting them up, the telephone company, of course, superintending the work and retaining control after the line is built.

Where the line has to leave the main road to reach a subscriber's premises the expense of building to the house should always be borne by the subscriber who, if he wishes, can furnish his own poles. Poles furnished as above should always be of standard size and length. Don't allow of bean-pole construction, except it may be on a side line to a subscriber's house. In communities that will not likely require long-distance service and which are unvexed by trolley roads, grounded lines will furnish a satisfactory means of communication. Some grounded country lines, as a matter of fact, are quieter than most metallic circuits in a city. If there should be several grounded lines paralleling each other for five miles or more there will most likely be more or less cross-talk. Most farmers will not, however, seriously object to this so long as it is not severe enough to interfere with their conversations. As to long-distance service the proper use of repeating coils will allow a very fair service from a grounded line up to 100 or 200 miles, which is about the limit for an ordinary instrument, anyway. It is generally advisable to use only No. 12 iron wire for lines of this character on account of its strength and cheapness.

As to the third proposition, the plan used in a great many Indiana and Ohio towns is simple. In the first place the number of telephones on one line is limited to six and the limit is rigidly adhered

to. The solicitor will go to a group of farmers and propose to put six telephones in that neighborhood at a cost of $18 per year for each instrument in consideration of a three years' contract, the company agreeing to put in bridging instruments and metallic circuits. This charge of $18 per year is for distances of from two to five miles from the exchange or the city limits. Having made this proposition to the farmers along the road he leaves several blank contracts with them and lets them form their own club, as it were, by deciding who shall join them, at the same time telling them that when six names are turned in the line will be built. This leaving them to select their own company in a line of this kind is more satisfactory to subscribers than if placed promiscuously at the pleasure or convenience of the company. It may be, of course, that some one will be left out of a club of this kind who desires connection, but he can be taken care of in subsequent installations. This plan generally results in having every well-to-do farmer within ten miles of town becoming a subscriber.

By means of bells of fixed polarity and direct-current generators it is possible to ring four subscribers selectively; that is, only the one bell desired will be rung, or, if there is no objection to ringing two subscribers at once, eight can be connected to the same line. A system of this kind saves subscribers the annoyance of continual ringing, and also contributes to secrecy by concealing the calls from all but the persons wanted, and simplifies the signals to one ring on a four-party, one and two rings on an eight-party, or one, two and three rings on a twelve-party line. It, however, requires a direct-current or impulse generator at the exchange and a four-button ringing key at the board. When there are party lines of this kind to deal with it is best that they should be confined to one section of the board and under the care of one operator who knows the lines and their various combinations.

Do not place more than six subscribers on one line. This is a good rule to go by. It is better to have two five-party grounded lines than one ten-party metallic-circuit line.

Fifth condition—As before stated in these articles, all poles should measure not less than twenty inches around the top, and should be set in the ground as though intended to stay there twenty years. They should also be roofed and gained, and roof as well as gains filled with a good oil paint.

If there are only two wires to string on the line, brackets may be used, but if there are more cross-arms should be put on. Ten-pin cross-arms cost about $9 a mile more than brackets, but are more permanent and reduce the cost of future construction. All poles should be guyed where angles in the line occur, and should not be set further than from 140 to 150 feet apart, and 132 feet is better still, for if poles are set too far apart it is almost impossible to keep the wires tight enough to keep out of trouble. With poles set at the rate of forty to the mile and the wires properly pulled up there is no reasonable excuse for crosses or other line troubles,

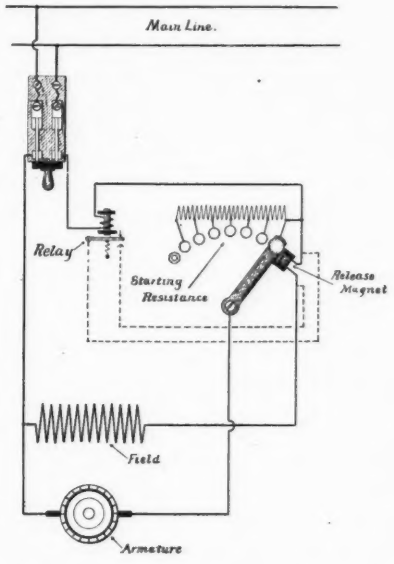


DIAGRAM OF STARTING RESISTANCE RELEASE DEVICE.

even though the pins are placed ten inches apart.

A few dollars extra paid out for poles may save many dollars in maintenance expenses in the future. If there is not money enough in the treasury to pay for a line of this kind, wait awhile or go in debt or build less line, but in any case build properly or not at all. As to the rate of $12 a year made by some rural communities, it can not be made remunerative unless it is possible to place about ten or twelve parties on one line and the line so arranged that they will not ring the exchange except for an exchange connection, which can be arranged by means of a grounded line so connected that they can ring the exchange by pushing a button. This will be discussed in the next chapter.

At the present stage of the art, party lines in town are not desirable except in the outlying residence districts, and only then when selective signaling can be employed.

A DEVICE FOR THE PROMPT RELEASE OF STARTING RESISTANCES.

BY H. C. HEIDRICH.

The sluggish action of the automatic underload release devices on motor starting resistances is the cause of a considerable number of damaged armatures, blown fuses, accidental fires, etc., due to the too prompt resetting of breaks at the switchboard of the power station after the motor armatures have fallen considerably below speed and are held across the line by the release magnet, which retains the starting lever at the "all-out" or running position. As a shunt motor continues to maintain its field through a very gradual and reducing speed for an appreciable time after the interruption of the circuit, the release magnet on the usual starting box being in series with the field of the motor remains sufficiently magnetized by the generator action to hold the lever until the speed of the armature has fallen to a point where it is unsafe to restart without inserting resistance.

It is customary for switchboard men to reset breakers promptly, frequently resulting in a hard "plug" for the motor armatures, and often opening the auxiliary breakers or blowing fuses.

To obviate this feature and to prevent the passage of abnormal currents, a very simple and inexpensive device can be employed, which consists of an ordinary relay, the bobbin of which is placed in series with the line, being wound with comparatively few turns, and of sufficient cross-section to carry the total current of the motor. The connections and devices are shown in the accompanying sketch. The purpose of the relay is to short-circuit the release magnet, making its action simultaneous with the line interruption. It will be understood that at no load there must be sufficient ampere turns on the relay magnet to separate its contacts, otherwise the release magnet being short-circuited could not retain the starting lever at the running position. The proper winding for the relay can readily be determined by one or two trials, or a comparatively high-resistance winding and shunt may be used, as a very light spring on the relay armature will allow sufficient adjustment to cover a very wide fluctuation of current to the motor. The action is practically instantaneous and it is impossible to break and reclose the main circuit, however rapidly, without the necessary and desired action of the relay and the consequent prompt protection to the apparatus through the opening of the armature circuit.

A COMBINATION PUBLIC SERVICE PLANT.

A SUCCESSFUL EXAMPLE OF CONSOLIDATION OF PUBLIC WATER, GAS AND ELECTRICITY SUPPLY.

The sharp competition which has existed in many places, especially in the smaller cities of the United States, between gas and electric light supply companies has so reduced the profits of both enterprises in many cases as to remove them from the category of paying businesses. It is beginning to be well known that where such properties have been consolidated there has usually been a considerable increase in the consumption of both utilities. Often the customer prefers to use both; as, for example, when gas is supplied for heating and cooking purposes, and electricity is supplied for light. Also, in many places it is possible to arrange so that gas may be used exclusively for lighting in the daytime, thus permitting, in some cases, the station to be shut down. Indeed, it is beginning to be believed that the consolidation of such public utilities as water supply, gas and electricity supply, and sometimes hot-water heating, is the best solution of many difficulties confronting the companies now separately operating such services.

In the case of Franklin, Ind., less than three years ago the electric light, gas and water interests were owned and operated by different parties. It is stated that at that time none of these plants was making its fixed charges, and that they were all rapidly drifting toward a receivership. The properties were centralized and consolidated by Mr. A. M. Barron, of Chicago, a consulting engineer, who has had considerable experience with such properties and their management, and upon a site in the centre of the town an entirely new plant was erected for the gas, water and electric light supply systems, and a system of hot-water heating was also installed.

This plant presents so many elements of interest on account of its successful operation that it merits a somewhat exhaustive description and illustrations.

Franklin is the county seat of Johnson County, and is an attractive, well built city of about 5,000 population, with an assessed valuation of a little over three millions. The city is situated in a rich and fertile farming district, twenty miles from the capital, Indianapolis, ninety miles from Louisville, and ten miles from the city of Columbus, Ind. There are two railroads, one the Louisville division of the Pennsylvania, and the other the Martinsville branch of the "Big Four."

It is a city of pleasant homes, and as the seat of Franklin College it attracts to it many wealthy and retired farmers of the surrounding country for the education of their children. As is well known, these people are among the best patrons of the utilities of life, such as water, electric light and gas; and, as they have the money, all bills are settled promptly. Franklin never had what is termed a "boom," but has advanced steadily and conservatively, and the brick blocks, paved streets, and prosperous looking residences are an evidence of permanency.

The city is well governed, has practically no debt, and seems certain of an increase in population and wealth. The recent extension of the Indianapolis, Greenwood & Franklin Electric Railway to Franklin has already attracted to its borders some of the wealthy business men of Indianapolis, who propose to bring their families to Franklin to take advantage of the educational features, going and coming, from and to, their business on the Inter-Urban. This in itself will be not a little addition to the services of the electric light company.

The power plant of the Franklin Water, Light and Power Company is located on a lot about 100 feet front on West Jefferson street, 311 feet along the main tracks of the "Big Four," thence about 288 feet east and north, back to the street; distant only one square from the business district, two squares from the court house and county jail, and in the centre of the residence district.

On the above lot, the company has just completed a consolidated brick plant of the most modern construction. It has a frontage on West Jefferson street of eighty-six feet, extending back about 100 feet, excepting about fifteen feet in the rear centre, which has been left open for the purpose of facilitating the handling of material and supplies, and it is expected to use this space later for the pumps and other apparatus for hot-water heating for the town. The building is divided by transverse walls of brick, twelve inches thick. One room, forty by fifty feet, is occupied by the engines and dynamos and air compressor; next to this, in a pit five feet deep, is located the pumps; directly over the pump room, in a second story, in which are located the offices and storerooms of the company. On the west, next to the railroad tracks, is located the gasworks; recently constructed and adjoining this, just outside, is the 25,000 cubic feet capacity gas-holder, with steel tank instead of the old masonry cistern.

In the rear of the dynamo and engine room are located the three boilers of the company which supply steam for the engines and pumps. In the rear of the lot a brick reservoir, with slate roof, has been built of the following dimensions; 145 feet long, forty-five feet wide and eighteen feet deep, holding 900,000 gallons of water. The gasworks also has a slate roof, and the roof of the dynamo, engine, boiler and office part is composition.

There is a strongly built cement cistern of large capacity for the storage of tar, and sheds are being built on the lot for the storage of coke and gas and steam coal. There is a side track from the "Big Four" into the company's lot, extending to the east end, which will hold a dozen cars. There is a coal conveyor operated by steam for the economical handling of the coal; one man only being necessary to put the coal from the car in front of the boilers.

The water supply consists of one-eighth-inch well 1,120 feet deep, and one-eighth-inch well 266 feet deep, which give up an inexhaustible supply of good wholesome water, the wells being operated either by direct suction, deep-well lift or by air compression. This arrangement, with the immense storage capacity of the reservoir, makes the supply of water practically inexhaustible. The company is building what is termed a gravel bed well, which will be eighteen feet square and forty feet deep. It will be surrounded by a thick wall and bottom of gravel, and will also give a large quantity of water.

The floors of the entire buildings are laid in cement; the walls in the office and storerooms are white hard cement finish, and the office is wainscoted and divided by necessary partitions; there are large windows, with plate glass, on each side, giving plenty of air and light. The front of the building is square, excepting the gasworks part, all being ornamented with cornices in pleasing designs.

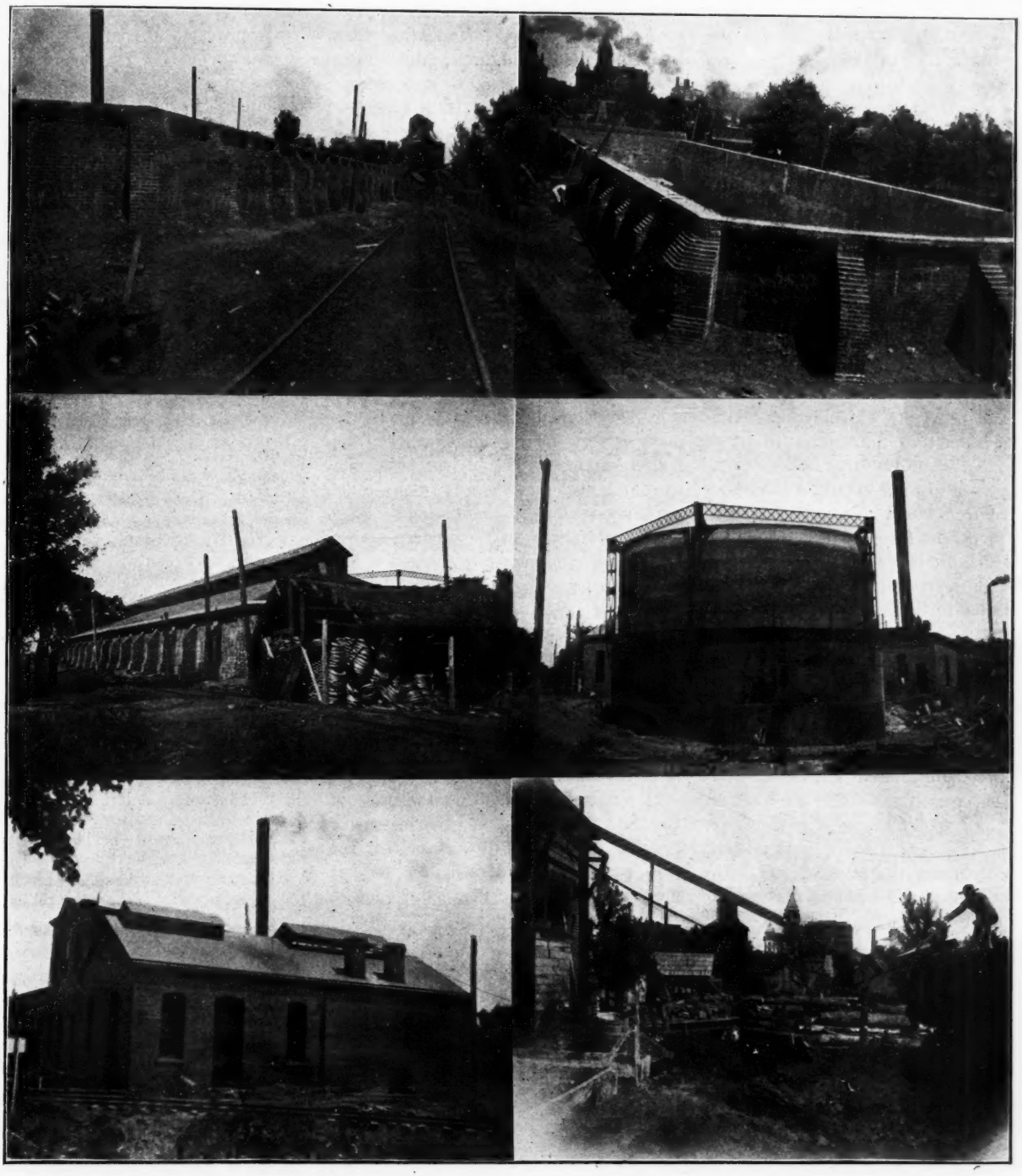
In the northwest part of the city, on the highest point, is located a steel standpipe, 12 feet by 142 feet high, giving a pressure of 75 pounds when full, or a fall of 150 feet.

The company has franchises for electric lighting, gas and water supply, including a city contract for sixty or more arc lights and seventy-eight fire hydrants.

The gasworks is installed in a three-room brick building of very solid construction, having concrete floor and foundations, the gas plant consisting of apparatus of the retort distillation type suf-

ficient for the production of 45,000 cubic feet every twenty-four hours.

The electrical equipment consists of two high-speed engines and three re-



1—Reservoir Showing Buttress Construction.
2—Reservoir before Roof Was Put in Place.
3—Completed Reservoir Showing Roof.
4—Steel Tank Gas-Holder.
5—Exterior of Consolidated Power-House.
6—Coal Conveyor.

SOME VIEWS OF THE COMBINED GAS, WATER AND ELECTRICITY WORKS AT FRANKLIN, INDIANA.

turn tubular boilers set in brick, the engines operating two fifty-light, ten-ampere, T.-H. arc machines, and one 120-kilowatt, sixty-cycle alternator of the General Electric type. A marble switchboard is installed, and in addition to this apparatus there is a thirty-five-kilowatt series transformer, fifty-six house lighting transformers and about six miles of pole line reaching various parts of the town. The water is raised from wells by means of an air-lift pump and received in the fine covered brick reservoir shown in the accompanying illustrations.

Since the consolidation of the properties the operation of the combined plant has been exceedingly successful and satisfactory. Mr. Barron is to be congratulated upon the success exhibited at Franklin, and the example afforded by this consolidation should point the way, it is believed, to others where similar conditions exist.

Some Averages of Electric Light Costs and Charges.

THE SUBJECT of the cost of fuel and the other necessities for the production of electric light, and the charges made for electrical supply by plants in various parts of the country, is one that appears not to have received any great amount of attention or investigation. Recently the ELECTRICAL REVIEW sent out a large number of enquiries to representative electric light stations in all the states of the United States requesting information concerning—

1. The price of coal.

2. Whether or not water power is used in the production of electric current.

3. Whether current is sold on the meter or contract basis.

4. The base rate of charge per kilowatt-hour and the minimum rate of charge per kilowatt-hour for large customers.

Responses to these enquiries have been received from a sufficient number of stations to permit the preparation of averages which are believed to be fairly accurate and representative. The stations represented in these averages are situated in all parts of the United States from Maine to California, and from Florida to Oregon. On account of the private nature of some of the figures given it is not possible to give the names of the stations represented in these averages, but all of them are representative stations of average size, operated as nearly as could be determined upon the lines of good average practice. The results are of great interest.

1. Concerning the price of fuel: The highest price paid for coal by the stations replying is $6 per ton and the lowest price $1 per ton, the latter representing slack coal, and the former "run of mine." The average price of coal paid by stations representing all but a few states is $2.96 per ton, delivered at the plants.

2. Concerning water power: Twenty per cent of the stations listed use water power either wholly or in part for power production.

3. Basis of sale of power: Nine per cent of the stations adhere to the old contract basis. Four per cent use both the contract and meter basis, while eighty-seven per cent use the meter basis entirely and exclusively in determining their charges for current supply.

4. The basis of charge: This is in many respects the most interesting of the figures obtained. The highest basic rate of charge made anywhere is twenty cents per kilowatt-hour, this rate being confined to a few stations in the eastern states. The lowest minimum rate charged is one cent per kilowatt-hour, this rate referring to a water-power plant operated in connection with a long transmission line and supplying customers with power for general purposes, including street railways. The average base charge per kilowatt-hour through the United States is 12.3 cents, while the average minimum charge to large consumers is 5.1 cents.

If we might assume that the price of fuel is a fair indication of a reasonable basis of charge, it will be seen that the rate per kilowatt-hour figures out at about four per cent of the cost of a ton of coal. In other words, the average efficiency of conversion of coal into power is at the rate of one ton for twenty kilowatt-hours sold. On the same basis, the average minimum is 1.7 of the cost of coal, representing an apparent maximum efficiency of conversion of one ton of coal into fifty-nine kilowatt-hours. This assumption, however, does not seem to be entirely warranted, since an examination of the data received shows that there is very little apparent connection between the price paid for fuel and the amount charged for power. For example, a station paying $5 for coal has a basis rate of ten cents, with a minimum of two cents; whereas another station paying only $1 for coal has a basis rate of fifteen cents and a minimum charge of five cents. Perhaps all that may be definitely claimed as shown by these figures is that other elements than the cost of fuel are the determining factors in the output cost of electric current, or else that the subject has never received that scientific investigation which is its due.

In the United States we are in a position curiously contrasted with that in which English central stations find themselves. In that country a legal requirement forces the publication of the figures of cost and charge, the former being analyzed very carefully for all public supply plants. The most immediate result of this publicity has been the close and accurate study of the costs of electric supply and the understanding on the part of station managers and the shareholders in such enterprises of the various elements entering this business. A large part of the stations in that country are earning satisfactory dividends upon the investment they represent.

Summing up the results as given above the table below may be constructed:

AVERAGES OF FIGURES OF COAL COST AND POWER CHARGES RECEIVED FROM REPRESENTATIVE ELECTRIC LIGHTING STATIONS.

	Lowest Cost of Coal.	Highest Cost of Coal.	Average Cost of Coal.	Average Base Charge for Power.	Average Minimum Charge for Power.	Per Cent Water Power.
Eastern States.....	$2.60	$4.90	$4.05	14 cents.	6.05 cents	17.0
Middle States.....	1.00	6.00	2.29	12 "	5.08 "	9.2
Southern States.....	1.33	3.50	2.42	11 5 "	5.50 "	24.0
Western States.....	1.80	5.00	3.68	7.5 "	4.00 "	29.8
All States.....	$1.00	$6.00	$2.96	12.3 cents.	5.1 cents	20.0

Electrolytic Preparation of Haloid Acetones.

These compounds have derived importance from their use in the synthesis of dyes and other organic products. M. A. Richards has described, in a communication to the French Academy, the reactions when an electric current is passed through a mixture of acetone and hydrochloric or hydrobromic acid, forming respectively, monochlor-acetone or monobrom-acetone. The method is superior to the direct application of chlorine, as in the latter case it is difficult to avoid the production of higher chorinated derivatives and colored by-products. Richards finds that with monochlor-acetone the yield increases with the intensity of the current, provided that an excess of acetone is present, otherwise there is a great loss of chlorine; 3 of acetone to 2 of HCl is the best proportion. The result is also better with a low current density at the anode, hence the latter should have a large surface. Heat diminishes both the yield and the purity, therefore the bath must be constantly cooled by water. The nascent hydrogen liberated at the cathode has little or no influence; the same result is obtained with or without a diaphragm.

The "Armorl" Electrocapillary Relay.*

We commented in our notes columns a short time ago upon the announcement that a new system of wireless telegraphy had been worked out by Messrs. Orling and Armstrong. From what could be gathered from the information at that time available we judged that the method made use of earth conduction; we have since learned that this is the case and that the inventors rely upon the novel design of their transmitting and receiving apparatus for the efficiency of their results. We have had an opportunity of inspecting drawings of the receiving apparatus, and are enabled to give a description of it, though we have not seen the actual apparatus itself, but only a working model. We understand that it is proposed to read a paper shortly on the transmitter before one of the scientific societies and that in consequence it is not desired to publish the details of its construction as yet. It is to be hoped that at the same time an account will be given of the experimental results obtained, with trustworthy data from which the probable value of the invention may be gauged, for as yet there is nothing to go upon but the statements of the inventors.

In the meantime we must content ourselves with giving a description of the receiver, which is of interest independently of its use with the Orling-Armstrong or any other wireless telegraph, as it could be used for the detection of any sort of electrical current. The instrument consists essentially of a capillary electrometer, which is arranged so that it can actuate a relay. The extreme sensitiveness of the capillary electrometer for very small currents and low electro-motive forces is well known, and the instrument is used considerably, especially for physiological work. The arrangement adopted in the present instance is shown in Fig. 1. A syphon, *f*, is filled with mercury, one limb dipping into a vessel of mercury, *a*, and the other into a bath of dilute acid, *b*, the level of the mercury being considerably higher than that of the acid. The mercury is prevented from syphoning over by drawing out at the end, *h*, of the syphon into a capillary tube. A contact is sealed into the top of the syphon at *i* and a second contact is made to the acid at *j*. When a difference of potential is set up between *i* and *j* in such a direction that *i* is positive to *j*, the capillary forces are overcome and the mercury syphons over; in so doing, the mercury, as it flows out of *h*, falls on to a delicately balanced lever, *k*, which is thereby tilted and makes contact with a stop, *o*, thus closing a local relay circuit. The level of the mercury in

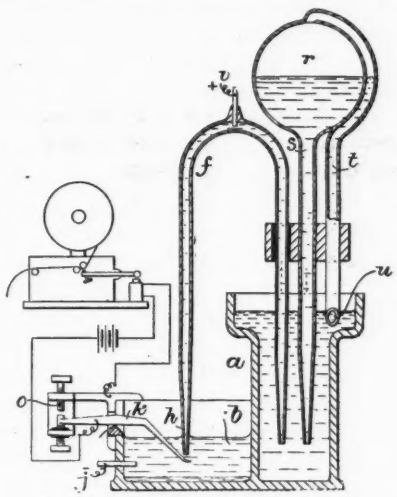


FIG. 1.—ELECTROCAPILLARY RELAY.

a is maintained constant by means of the arrangement shown to the right of the syphon; a reservoir, *s*, is partly filled with mercury, which is held up by keeping a partial vacuum in *r*; when the level in *a* sinks, the end, *u*, of the side tube, *t*, is opened, thus allowing a certain amount of air to enter and causing mercury to flow out until it again closes the aperture.

In a modification which has been devised the lever is arranged outside and beneath the vessel, *b*, which is then provided with a capillary hole at the bottom just above the end of the lever. The bottom

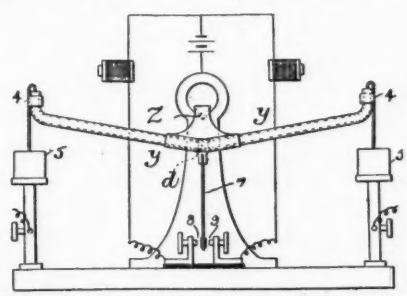


FIG. 2.—BALANCE FORM OF ELECTROCAPILLARY RELAY.

of the vessel is in this case covered with mercury, over which acid is poured until the forces of gravity and capillarity are just balanced. When more mercury syphons over, a corresponding amount escapes through the hole in the bottom of *b* and actuates the lever. The lever may here be replaced by two platinum points, the falling mercury being then made to bridge the gap between the points and thus complete the relay circuit.

An alternative form of the apparatus is shown in Fig. 2. A glass tube, *y*, is balanced on a knife edge, *z*, and is filled with mercury except for a drop of acid in the centre at *d*. The current is led into this tube through metal rods, 4, 4, dipping into mercury cups, 5, 5. If a current is passed through the tube the meniscus between the mercury and acid is displaced in the direction of the current and the balance is consequently disturbed, as one arm now contains more mercury than the other; the pointer, 7, is deflected and makes contact with either the stop 8 or 9 and thus closes the local circuit. The construction is, however, said not to be so satisfactory as that shown in Fig. 1. It is claimed that the apparatus is extremely sensitive and very trustworthy in its action, and even that it could be used as a substitute for the coherer in ætheric telegraphy or the syphon recorder in cable work; but these claims remain to be established in practice.

* From *Nature*.

Platinum in British Columbia.

Consul Dudley sends the following from Vancouver, December 7, 1901:

"The superintendent of the assay office here has reported to the press that among the specimens of gold brought to him to be refined, he has found considerable quantities of platinum, and he is under the impression that the miners do not know platinum when they see it. In all the placer-mining districts of British Columbia and the Yukon Territory, large amounts of platinum and kindred metals have been thrown away by miners, who did not know the value of the product. With the present price of platinum, it will pay prospectors to be on the lookout for this metal, which doubtless exists in considerable quantities in this province. Platinum is not found in ledges, so far as is known, excepting in one place in the world. It is found in black sand containing a large percentage of magnetic iron ore and a varying quantity of gold."

A vessel which has been specially designed and equipped for catching fish by the use of the electric light has just been finished at Norfolk, Va., by Mr. W. E. Cole. It is seventy-eight feet long, of light draft, and of large beam for its length. The purpose of having the vessel of light draft is to allow it to enter shallow rivers and places along the Atlantic seaboard which are not frequented by the regular fishing craft. In these places Mr. Cole plans to use his electric light to special advantage. The General Electric Company has constructed an arc light of high power, which is carried over the bow of the vessel, and the fish attracted by this light are caught in the nets attached to the vessel. This light is not submerged.

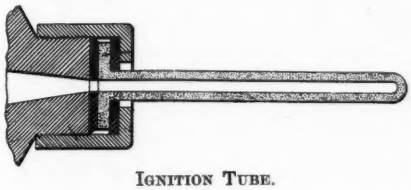
Electrical Patents

An important improvement has just been patented by Mr. William H. Marshall, of Cleveland, Ohio, in apparatus and machinery for the manufacture of carbon. The invention relates to a new and original lining, coating, facing or covering for apparatus and machinery employed in the manufacture of electric light carbons or raw materials for such carbons, the same including each and all of the numerous individual parts or devices wherein the material for making the carbons is in any wise handled or prepared or in or by which the carbons as such are ultimately produced, the same comprising, first, a carbon-lined retort or furnace for the manufacture of lampblack or tar; second, a carbon-lined chamber or receptacle for settling lampblack or tar; third, a carbon-lined mixing apparatus for mixing tar and lampblack; fourth, carbon rolls, or carbon-covered rolls for mixing or condensing lampblack and tar or calcined lampblack and tar; fifth, carbon-lined retorts or furnaces for calcining or igniting condensed or mixed and condensed lampblack and tar; sixth, carbon-lined mills containing carbon balls or carbon-covered balls for grinding; seventh, mills with carbon facings for grinding; eighth, carbon-lined furnaces or retorts for baking, and, ninth, generally the use of an exclusive carbon surface where hitherto other surfaces have been used and which have always been more or less deleterious to the carbon product because of their foreign nature, and therefore natural impurity. In the efforts heretofore made to manufacture high-grade carbons there has been a constant drawback and difficulty confronted by reason of the impurities that creep in here and there in the manufacture, notwithstanding all the precautions at every point and the employment of apparatus which has been as free as possible itself from such impurities, and from danger of shedding foreign particles into the carbon stock. Yet, notwithstanding all these precautions and the exercise of much expensive care for cleanliness at every point, it remains true that a percentage of corrupting and depreciating matter has always worked into the stock as it passed through the various stages of preparation, so that in the end a perfectly or practically clean carbon has not heretofore been obtained as a uniform and standard article of manufacture. Individual and exceptional carbons were practically pure and clean, but not the run of the factory nor any certain number at any time. The impurities entering into its construction were, moreover, generally such as came from the apparatus in or within which the carbon was being developed in manufacture and consisted of particles or possibly small flaky detachments from the brick, mortar, iron, steel, or other materials not carbon of an earthy or other injurious nature, with which retorts, furnaces, chambers, and other apparatus or machinery have hitherto been lined, covered, faced, or equipped. Such apparatus answers well enough for the cheaper grades of carbons; but it has been found altogether insufficient and defective for the production of carbons of the highest and purest grade, which are now in such large demand, and which must be wholly devoid of all deleterious and corrupting particles or substances. It is, therefore, the object of the invention to produce such perfect carbons as the normal and uniform output of a factory, and this is accomplished by employing a carbon lining for all furnaces, retorts, chambers, compartments, receptacles and other like utilities wherein the material is handled in any of the processes of its preparation early or late, and by providing a carbon covering for crushing rolls, balls and other surfaces and means employed immediately or remotely in the production of the finished carbon. This means that all of the apparatus throughout the factory is under a carbon coating of more or less depth and applied or affixed one way or another, according to the character of the apparatus or part. To these ends the lampblack or retort-carbon is produced only in carbon-lined apparatus and the calcining is done in carbon-lined retorts, and only carbon surfaces are employed in all the processes and stages of production throughout the factory where hitherto earthly or other depreciating materials were used. If a lining is desired, it is the practice to provide blocks, bricks, or sections of carbon of suitable thickness and shape to serve the purpose, and the edges of said parts are preferably made to interlock or to key or be keyed together or fastened by means of carbon in a plastic form rather than resort to mortar or other like means as might introduce impurities for securing them in place. If a roll or other part is to be covered, the carbon is cast or fashioned to conform thereto or thereon, and the lining blocks, slabs, or bricks, as well as the other parts of the carbon prepared for these purposes, are made as compact and dense as possible to prolong their serviceability. The rolls and balls herein referred to may be either solid carbon throughout or have cores faced, coated, or covered with carbon, and if so faced or covered the carbon may be applied as a paste or in other plastic or pliable form, and the linings of chambers or other receptacles, tanks, vats, furnaces, and the like may likewise have their working or exposed surfaces covered, coated, or lined in a like manner or in any manner that is found practicable. The invention therefore consists more in the having of a carbon faced or covered surface piece or part for use in carbon manufacture to exclude deleterious substance and preserve carbon purity than in any special shapes or forms into which the carbon may be wrought to effect this result or in the manner of its application or use.

Señor Jose M. Ancira, a Mexican, residing in New York city, has been granted a patent on a new non-conductor composition which is made up of the following ingredients; namely, cotton or other organic fibre, by weight one part; powder slaked lime or cement two parts; milk in sufficient quantity to make a sticky paste. These ingredients are thoroughly mixed and rubbed or ground together in a suitable vessel until the cotton or other fibre used is disintegrated and the whole mass becomes a thick paste. This paste may then be applied in its moist state to the surface of any conductor which it is desired to insulate and allowed to dry thereon, or it may be moulded and pressed into blocks or plates of any desired shape. For ordinary purposes the pressure applied in moulding need be but slight, but when it is employed for insulating conductors carrying currents of highest potential, better results are obtained if the composition be subjected to a high degree of pressure. The composition when dry is light and tough, and may be perforated without cracking or breaking it, and it may be cemented together or in place upon any surface to be protected. The insulating properties of the composition are improved by covering it before it becomes set with silica in a powdered state, and then subjecting the whole to a high pressure. The particles of silica are thereby forced into the mass and form a coating on the outside of the compound. It may also be rendered fireproof by treating it with a solution of alum which will not impair its properties as a non-conductor of electricity.

Professor Elihu Thompson has invented a new ignition tube for gas or oil engines, which possesses remarkable qualities that will make it very useful in this art. The tube is constructed of practically the usual

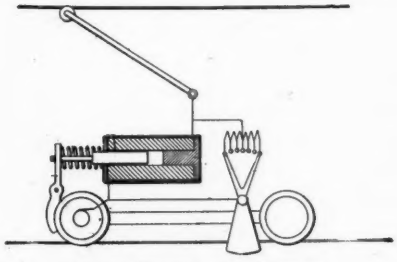
form, comprising a comparatively small shank having a bore, and provided at one end with an annular flange by means of which it is secured to the cylinder of the engine. The feature of novelty resides in the material from which the tube is formed; namely, fine quartz, which is



IGNITION TUBE.

fused at high temperatures. This material has a very low coefficient of expansion, and it will stand heating red hot and plunging into water. It will also resist extremely high temperature without softening. In other words, it forms an ignition device which is practically indestructible, unoxidizable, is strong, and will resist a bright red heat, or even a white heat. An advantage that it has over the ordinary device lies in the fact that it will not break if water or oil is accidentally dropped thereon when it is in a heated condition.

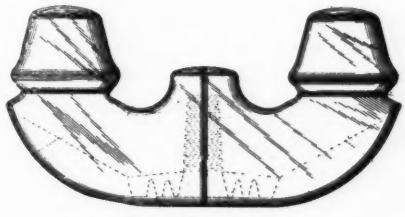
A novel idea in speed regulating devices for overhead electric carriers has recently been devised by Mr. Arthur S. Clift, a resident of East Arlington, N. J., whose object is to provide means which will automatically apply a brake to the carrier on a down grade, with a pressure corresponding to the steepness of such grade. To this end he employs a solenoid which is connected in series with the motor that operates the carrier, and within this solenoid is a metallic plunger having a connection with a brake lever. A spring also engages this brake lever, normally tending to keep the brake applied to the



SPEED REGULATING DEVICE.

wheel. By this arrangement it will be seen that the current passing through the solenoid and through the motor will hold the plunger inward and thus keep the brake off the wheel, against the force of the spring; furthermore, that when the current is broken or interrupted said spring will apply the brake. Running around the solenoid is a shunt circuit which has a rheostat as a part of it, and a weighted pendulum is hung upon the carriage with its upper end arranged to contact with the contact pieces of the rheostat. As a result, when the car or carrier is tilted going down a grade, the pendulum will maintain its vertical position, and consequently its upper end will swing over the contact pieces, thus cutting out a certain amount of resistance and allowing a certain portion of the current to pass around the solenoid. The action of the spring therefore on the brake is increased, and as the power of the solenoid is sufficient to keep the brake off the wheel under normal conditions, the shunting of a portion of the current will put the brake on. It will be obvious that the steeper the grade the greater will be the swing of the pendulum, and consequently the greater will be the force with which the brake is applied.

Messrs. John F. Duffy and Henry B. Hershey, residents of Scranton, Pa., have patented an insulator which is designed to supplant the "pipe arm" insulator now in



NOVEL INSULATOR.

general use. These "pipe arm" devices are arranged to bolt through the arm of the pole and support two wooden pins, so that in order to place one of them in position it is necessary for the lineman to drill a hole in the cross-arm and bolt the arm on. In the use of the present device it is only necessary to remove the single insulator on which the wire is tied and replace it, screwing the improved device on the same pin. The invention, therefore, consists of a double-knobbed integral insulator, comprising a central body portion having a screw-threaded socket that receives the pin. From this body portion project two oppositely disposed integral arms carrying at their outer ends upstanding knobs having the usual grooves in which the wires are secured. From the above it will be seen that the double insulator may be attached to a cross-arm by means of a single pin of the kind now in use for the single insulators. In case it is desired to break the main line wire and put in a loop, it is only necessary to remove the single old-style insulator from its pin and replace it with the improved double-knobbed structure.

Oxygen and Hydrogen Gases by Electrolysis.

The production of oxygen and hydrogen gases by the electrolysis of solutions of caustic alkali has now become a successful sub-branch of electrochemical industry, and at Rome, Milan, Zurich, Lucerne, Hanau, Brussels and Paris, installations of this kind are in operation, says *The Electrician*. Several different forms of apparatus have been devised for carrying out this decomposition of water and separation of the gases liberated. A recent one, the Schuckert electrolyzer, consists of a cast-iron tank containing a large number of iron bells, one of these latter being used to cover each electrode and to collect the gas liberated at its surface. A fifteen per cent solution of caustic soda is used as electrolyte, and a continuous feed of distilled water is required to replace that decomposed by the electric current. The best efficiency is obtained with this apparatus at seventy degrees centigrade, with an electro-motive force of 2.8 volts, and in order to guard against loss of heat the electrolyzer is embedded in a wooden box filled with dry sand. Rubber tubing is used to conduct the gases from the "bells" to the gas-holders, rubber being used to prevent short-circuitings between the latter and the cell. A Schuckert electrolyzer of normal size is 660 mm. in length, 450 mm. in breadth and 380 mm. high, and requires for charging fifty litres of sodium hydrate solution. With a current of 600 amperes this electrolyzer produces per hour 220 litres hydrogen and 110 litres oxygen, measured at fifteen degrees centigrade and 760 mm. pressure. An installation composed of forty such electrolyzers, with the necessary building and accessory apparatus, would cost £900. Using power costing £7 10s. per kilowatt year, 300 cubic metres of oxygen and hydrogen would cost together £3 1s. 3d., or about 2½d. per cubic metre. The cost of compressing either gas for storage in cylinders adds from 2½d. to 3d. to this amount, and would thus raise the total cost to the user to 5d. or 5½d. per cubic metre. This is equivalent to 1d. per seven cubic feet of gas, and there should be no difficulty in finding customers for compressed oxygen or hydrogen gas at this low rate of charge. In London, of course, the electric supply companies would charge more than £7 10s. per kilowatt year for the energy required. As such works would only take current during the hours of daylight, however, terms could be arranged which would still leave a profit to the manufacturer while permitting the compressed gases to be retailed to the consumer at prices well within the present limit of 3d. per cubic foot. The use of hydrogen gas, in gas engines of special design, as a motive agent for motor cars is likely to receive practical study now that a supply of the compressed gas at low rates is at the command of motor-car engineers.

NOTES ON X-LIGHT.

BY WILLIAM ROLLINS.

NOTE CXXXVI—ON LOWERING THE INITIAL RESISTANCE OF AN X-LIGHT TUBE.

At an early date I showed that the quality of the X-light produced by vacuum tubes did not depend entirely upon the degree of the vacuum, as was supposed, but upon the way the current was sent through the tubes and on the condition of the gases amalgamated with the terminals. This was important because it proved the necessity not only of exhausting the air from the tubes, but also the gases from the terminals to such an extent that those remaining did not come out too rapidly while the tube was lighted; for the effect of a rapid liberation was to produce a mist in the tube through which the particles from the cathode must force their way to the target. As a result they did not strike with sufficient force to become efficient radiant centres for X-light. the energy of the current expending itself in heating the target, thereby producing light of ordinary wave-lengths instead of X-light. I found when the terminals had been properly exhausted (or until use did not quickly produce the result mentioned) that the resistance of a new tube prepared for photographing the thick parts of the body was so high there was danger of puncturing by the current in attempting to light the tube. Therefore the importance of some method for temporarily lowering the resistance was evident. The method selected was one invented by Crookes during his work on high vacua. He found when caustic potash was strongly heated until most of the water vapor was driven off, the potash would take up part of the water again. To regulate the vacuum in a tube he placed boiled-out potash in a small bulb connected with the tube, applying the heat from a spirit lamp to liberate the water. His method, though sufficient for experimental purposes, was not convenient or delicate enough for practical work with X-light tubes. I therefore placed a piece of fine platinum wire in the bulb containing the potash, bringing the ends to the outside where they terminated in loops to which were attached the wires from a source of electricity. When the current was closed the wire became heated, liberating particles which lowered the resistance of the tube. By graduating the temperature of the wire it was possible to keep the requisite number of particles in the tube to ensure the X-light being of any desired quality; from the short waves necessary to penetrate the thick parts of the body without so much diffusion as to obliterate structure, to the longer waves required for showing marked contrasts between tissues differing but little in density. In another regulator the platinum was in the form of a spiral wound on a tube of mica which slipped over the tube containing the potash. Several simple means were devised to regulate the number of particles in the tube by varying the temperature of the platinum wire. When a constant and abundant source of current, as from a street main, was available it was only necessary to have a variable resistance in series with the wire, the adjusting handle of the rheostat being placed near the operator's hand, that he might control the heat while making the exposure by X-light. Such a source of current was not found necessary, a few dry cells answering every purpose, only in that case a variable resistance was not desirable for one could not afford to degrade the limited supply of electricity into heat by a resistance, except in the platinum itself. To meet this condition a revolving disc of hard rubber or other insulating material was devised with radiating strips of metal fastened to the side; connection with the electric circuit being made by two bands of metal, one on the axle, the other movable from near the centre to the periphery of the disc. When the movable strip made contact with the radiating arms near the centre of the disc the current could flow through the fine platinum wire in the regulator during one revolution of the commutator for a longer time than when the movable strip was near the periphery. I designed several other simple means of accomplishing the result, but they are not given here because this note is not intended to describe mechanical devices, but to call attention to a principle which is still overlooked by most makers of tubes—namely, lowering the initial resistance of an X-light tube and maintaining the vacuum at any desired point by electrically produced heat in a substance (not necessarily potash) the liberated particles being allowed to pass back into the chemical, by reducing the temperature of the platinum wire, as the particles coming out of the terminals into the tube increase in number through the continued lighting of the tube.

A second reason for this note is as follows: I have stated that X-light was a result of the high temperature produced in the particles of the cathode stream by their impact on the target, and finding a spectrum like one attributed to hydrogen I expressed the opinion that the initial brilliancy of an X-light tube was due to light subatoms in the cathode stream, some of which were hydrogen. Recently Trowbridge has said that the spectrum usually attributed to hydrogen is due to water vapor, and that X-light is not caused by the heat of bombardment, but by the dissociation of water vapor at the target. Therefore a description of a simple means for operating a water vapor regulator should be interesting to those who are studying his theory.

New Method of Hardening Steel in Germany.

A translation of an article on this subject has been sent by United States Vice-Consul-General Murphy from Frankfort. It is as follows: The Technical High School in Charlottenburg has just completed a series of experiments with a new method for preparing steel, and the result will no doubt attract much attention in interested circles. Experts claim that this new invention may revolutionize the entire metal industry. The inventor, named Giebeler, is a small manufacturer in Mecklenburg who has for years been interested in this new process, but was unwilling to bring it before the public until it had been thoroughly tested by experts. The results reached at the Technical High School were most satisfactory. By the Giebeler process, all sorts of iron can be given strength and hardness double that obtained by the Harvey, Krupp and Boehler processes, in spite of the fact that the cost of production is reduced fifty per cent. Projectiles fired against a seven and three-quarter-millimetre (0.305 inch) sheet of steel produced by the Giebeler process penetrated only to the depth of one millimetre (0.039 inch), while a similar sheet of Krupp steel was completely penetrated. With sword-blades of this material, other sword-blades can be shivered as if they were made of wood. A representative of Mr. Giebeler will start next week for Pittsburgh, to bring the invention to the attention of the great steel kings of America.

Native Calcium Carbide.

It has been announced in a Russian paper that a mine or deposit of calcium carbide has been discovered on the right bank of the river Waga, twenty versts from the town of Schenkensk, in the province of Archangel. This valuable piece of intelligence is surely equal to any of the efforts of our half-penny press.—*London Electrical Review.*

INSPECTION OF ELECTRIC METERS IN MASSACHUSETTS.

BY ALTON D. ADAMS.

At its late session the legislature of Massachusetts provided for state inspection of electric meters. Such inspection may be had on the application of any electric lighting company, or of any customer of any such company, to the board of gas and electric light commissioners. No provision is made for the general inspection of electric meters, or otherwise than on the application of a customer or company. If the meter of which inspection is desired is on the premises of a customer, it is the duty of the board to make such a test of it as in its judgment is practicable. A certificate showing the result and expense of such test is to be furnished to the company and to the customer. If a meter is found to be incorrect the board may order that it be corrected or removed, and that a new meter be put in its place. A meter is deemed correct for the purposes of the act if it does not vary more than five per cent from the standard approved by the board.

The person or persons making application to the board for a meter test must, in all cases, pay the expense of the test. If the application is made by the company which furnishes the meter, the payment of the cost of inspection by this company ends that part of the transaction. If the application for meter inspection is made by a customer, and the meter proves to be more than five per cent too fast, the company is required to pay a sum equal to the cost of inspection to the board, and the board subsequently pays this sum to the customer. No fee for inspection or test of a meter is fixed by the act, but the power to prescribe such fees is delegated to the board. The compensation of the person selected by the board to inspect meters is to be fixed by the board, but the act provides that the sum of this compensation and of his traveling and other expenses shall not exceed $3,000 in any one year. If the sum of the compensation and expenses of the inspector in any year exceeds the sum of the fees received for examinations and tests, this excess is to be assessed on the electric light companies in the way already provided by law for the other expenses of the board.

The word "company" in this act is made to include "every person, partnership, association, corporation and municipality engaged in the sale of incandescent electric light or electricity for incandescent lighting."

It seems probable that this act, until amended, is capable of only a very limited application. In the first place, an electric company is usually in a position to test its own meters, and as the company must pay the expense of any state test for which it may apply, whether the meter proves to be right or wrong, it is safe to assume that customers will make most of the applications for meter tests.

Even on applications for tests by customers there is a considerable check because the expense of a test, especially at any great distance from Boston, must be considerable, and this expense the customer must pay if the meter does not register too fast by more than five per cent, according to the standard fixed by the board. Owing to the peculiar meaning given to the word "company" by the act, it seems that a state test can not legally be made of a meter measuring energy from the circuits of a street railway company, or of a company furnishing energy for stationary motors and arc lamps only. This conclusion follows because none of the kinds of service named includes "incandescent electric light or electricity for incandescent lighting."

Probably the most serious impediment to the operation of this act exists in the limit of $3,000 put on the sum of compensation and expenses for meter inspections in any year.

If, as seems probable, the work of state inspection of meters is done by one or more experts located in Boston, the item of traveling expenses may easily consume more than $3,000 per year. Massachusetts contains about 100 electric companies and municipalities that operate electric systems in nearly all of more than 200 cities and towns above 1,500 population each. Assuming an average cost of each test at $10, $3,000 will not pay for two tests per year in each city and town using electric light.

A site upon which the building for the Bureau of Standardization will be built has been secured in Washington, D. C. It is situated on Pierce Mill road west of Connecticut avenue. Twenty-five thousand dollars, which is the entire amount of the appropriation available, was spent for the site. The latter is said to be particularly adapted for the purpose, being entirely free from mechanical and electrical disturbances, and at a sufficient elevation to meet the requirements of atmospheric conditions. Two buildings, to be erected at a cost of $250,000, have been authorized, and will be begun at once.

Electrodes for Hardening Plates.

A naval officer, Lieutenant Cleland Davis, U. S. N., has recently devised a process of cementing iron or steel. The invention is particularly adapted to the manufacture of hard-faced armor plate; but it is also applicable to hardening the tread of rails of steel or iron, or of hardening the face of other plates of steel or iron when desired.

The inventor subjects the face of the plate, either progressively or the entire face at one time, to the action of heavy electric currents passing either from carbon electrodes or through a mass of carbon which may be in a granulated form. The face of the plate within the path of the current is soon brought to a high heat and is impregnated to a greater or less depth with particles of carbon carried either from the electrodes or from the arms of granular carbon placed over the face of the plate. The depth to which the carbon will be carried and the consequent hardening which will occur will vary with the electric current and with the time that the treatment lasts. Where it is desired to harden to a considerable depth below the surface, the treatment may be prolonged; but where it is desired to harden only to a slight depth the treatment will be shorter. Since it would be ordinarily difficult to secure current enough to treat the entire face of a large armor plate at one time, it may be preferable to treat portions of the plate progressively, which may be done either by moving the electrodes over the plate or by moving the plate under the electrodes or by shifting the current from one group of electrodes to another, in the meantime keeping the plate and the electrodes in the initial position. In the same way, where rails or plates are to be treated the electrodes can be moved along the rail or the rail moved under the electrodes, as may be preferred. Where portions of the plate are treated progressively, the conductivity of the metal will ordinarily speedily produce the desired chilling effect, or this may be supplemented by means of a spray of water or other chilling agent.—*American Manufacturer and Iron World.*

American Electrochemical Society.

Over 200 persons have been enrolled already for membership in this proposed new society. The first meeting for definite organization, and for the reading and discussion of papers, it is expected, will be held in Philadelphia about Easter, and an enthusiastic gathering of electrochemists from all over the United States is assured.

DISTRIBUTION OF ELECTRICITY IN CITIES OF MODERATE SIZE.*

BY WILLIAM LISPENARD ROBB.

In dealing with the question of the distribution of electricity, it is impossible to lay down any but very general principles that will apply to many actual cases. Each individual case will be governed largely by existing local conditions. Much that would be desirable if a plant were being laid out new is found impracticable when the conditions of an existing plant are taken into account.

Cities naturally divide themselves into groups according to population, and for the purpose of this paper I have considered "cities of moderate size" as including those having a population of 200,000 or less. A satisfactory solution of the problem of electrical distribution is manifestly different in cities of this class from that in the large metropolitan cities.

Indeed, in dealing with the problem in cities of moderate size, a system of distribution that would be satisfactory for the smaller cities of the class would not meet all the requirements of the larger cities. No exact limitation can be placed as to the point at which the requirements materially change, as they are largely governed by local conditions other than population. It seems to me, however, that cities having less than about 50,000 inhabitants make a class by themselves.

In cities of less than 50,000 inhabitants a very considerable area has to be lighted; in general extending out from two to three miles in all directions from the central station. In a considerable portion of the city electricity will be required only for street lighting. Then fifty to a hundred miles of streets will have to be lighted, and arc lighting will generally be required for this service. It will be necessary to supply electricity for incandescent and arc lighting and power wherever desired. In general, in the cities of this class, there will be practically no tendency to put in isolated plants. There will be found little, if any, objection to overhead wires. If any wires should be required to be placed underground, it will be only in a very limited section of the city, and the total amount of electrical energy supplied from the underground wires would be small. The commercial lighting and power in a city of this class would not be concentrated, but scattered over several square miles. The demand for variable speed motors would be too small to be taken into account. The total amount of electrical energy would be too small to warrant the maintenance of more than a single station.

Under all these conditions it seems to me that only three-phase alternating current, having a frequency of sixty cycles and under a pressure of about 2,300 volts, should be generated.

The street arc lighting should be by constant-current series enclosed-arc lamps. The distribution for lighting would, in general, be single phase, and if motors of three horse-power or under only were used, it would be best to operate the motors from the single-phase lighting system. My own experience has been that single-phase motors above this size are not satisfactory as compared with polyphase motors, and will not meet all the requirements. Any city central station should be capable of supplying power for any purpose, and should be able to supply current for electrolytic and storage battery work. When the motors required are large, three-phase motors should be used, and three-phase rotary converters installed on the customer's premises should be used for electrolytic purposes.

The city should be divided into sections, and the different sections supplied from the different phases. If at any one point in any section large motors or rotary converters are required, the additional primary wire would be brought from the nearest point in the adjoining section. Satisfactory service will be given with light and motors supplied from the same circuits.

In sections where there is any concentration of lighting and power, a 220-volt, three-wire system of secondary wiring should be used, and be supplied if the system is small from a single transformer, or, if the system is large, from transformers suitably located at several points. I do not think it would be found desirable in practice to cut out any of these transformers during the hours of light load.

In the larger of the cities of moderate size a different set of conditions exist, and the problem of electric distribution is very materially modified. The area lighted is very large, and while commercial lighting and power are concentrated in sections, lighting and power service has to be supplied in practically all parts of the city. There is a tendency for the department stores, office buildings and large manufacturing industries to put in their own electric plants, and there is a growing demand for the wires in the business section to be put underground.

In cities of this class there are generally two sections where the demand for electricity is concentrated—the business section, where are located the large stores and office buildings, and the manufacturing district. Each of these sections has its own characteristics. In the business district the use of the large motor is largely confined to elevator and other service where the load is exceedingly variable and intermittent, and at the same time the very best lighting service is insisted upon, both as regards the constancy of the lights and the absolute certainty of the service. As a rule, in the manufacturing district, the percentage variation in load on the motor service is very much less than in the business section, the only variation that seriously affects the lights occurring when the machinery is started in the morning and after the noon hour. At these times there is practically no lighting. While the demand that the wires in the business section should be placed underground must be heeded, there is practically no demand for it in manufacturing districts.

The central station should be located at a point where coal can be delivered directly from the boat or railroad, and where water for condensing can be readily obtained. In nearly all places, this means that the generating station will be situated a considerable distance from the business section of the city. The conditions existing in the business section of a city of this class, as against the concentration of load, the intermittent character of the motor load, the necessity and the desirability of underground wires. The existing investment of central station and customers in direct-current apparatus, isolated plants, and the relatively high price charged at present for alternating currents and arc lamps, motors, etc., make it desirable to supply the business section at the present time with direct current.

Considering that it is desirable to supply both commercial, incandescent and arc lighting, and also motors from the same system of wiring, it seems best that the current should be distributed on the three-wire, 220-volt system. This voltage is preferable to a 440-volt system, as in my opinion the saving in copper required for the distribution, if the higher voltage is used, is much more than counterbalanced by the inferiority of the 220-volt arc and incandescent lamps as compared with the corresponding 110-volt lamps.

In general, the situation of the power-house most suitable for the cheap production of electricity will not be in the business district. The needs of a city of moderate size would also not justify the operation of two power-houses. The elec-

* Read before the American Institute of Electrical Engineers on November 22, 1901.

tricity for the business district should, therefore, in general be supplied from a rotary-converter substation, situated as near as possible to the centre of distribution of the business district.

The main power-house should generate only alternating current. This should have a frequency of sixty cycles, be a three-phase, four-wire system, and have a pressure of, approximately, 2,300 volts between each phase wire and the common wire. The four-wire, three-phase system is preferred, owing to the saving of copper over other systems that would prevent the using of standard 2,300-volt transformers and other standard line materials. Sixty cycles should be used, as arc-lamp motors, incandescent lamps and rotary converters for supplying the 220-volt direct current can all be operated satisfactorily at this frequency, and at no other frequency at which generators are now made commercially.

The electricity from the power-house to the rotary substation should be transmitted on the three three-phase wires, the common fourth wire being omitted. Boosters would not be required, and the pressure in the direct-current side of the rotaries would be varied by means of the static transformers used in connection with the rotaries.

The direct-current distribution from the substation should be underground. Not only is this demanded by the public, but in the business section of the cities, I believe that, interest or investment cost of maintenance taken into account, it is decidedly cheaper, as well as much more satisfactory, to maintain an underground than an overhead system of distribution.

The feeders should be lead-covered cables drawn into conduits, as feeders are liable to have for short periods considerable overloads, and there are no branches to be tapped off. I believe paper insulation is more satisfactory as well as cheaper for feeders than rubber.

The distribution boxes should be of the manhole type, or, better still, of the lamp-post type. The old style of Edison box blocks traffic too much to be installed at the present time.

When frequent services have to be made there is nothing so satisfactory as the old Edison tubes. When the services are infrequent the most satisfactory system is to use lead-covered, rubber-insulated cable drawn in ducts as distributing mains, carrying a single service into each building, from a small distributing box placed at every other property line. Arc lighting, incandescent lighting and power should be all supplied from the same system of distribution.

Outside of the business section the electricity should be supplied for all purposes on the alternating-current system. The current should be taken to the power-house from various distributing centres on the four-wire, three-phase system. From these centres of distribution single-phase circuits should be run for the operation of commercial arc and incandescent lighting and small motors. Additional phase wires would have to be taken from the centres of distribution to manufacturing plants where large motors were used.

When the lighting is at all concentrated, the lighting and motors should be supplied from three-wire, 220-volt secondary mains, fed by large transformers, and it will be found desirable to ground the neutral wire thoroughly.

The street lighting should be by series constant-current arc lamps. In some cases it would be desirable to supply the current for these from transforming devices located at the central power-house. In other cases the transforming devices could be most advantageously located at the centres of alternating-current distribution, as thereby the number of wires could be materially reduced, a few large wires taking the place of a very much larger number of small wires.

In order that a system of alternating-current distribution of any size should be satisfactory, it is necessary that the arrangement of the power-house be such that current be supplied to the different feeders at different pressures. This can be done by boosting transformers in each feeder circuit, and by a system of pressure wires brought back to the power-house from the various centres of distribution, or by the automatic device of Mr. W. L. R. Emmet.

The successful introduction of the Nernst lamp into the fields of incandescent and arc lighting, and the development of the steam turbine should have a marked effect in favor of the generating and distribution of alternating current. On the other hand, the air is full of rumors of marked improvements in storage batteries.

Telephony in Finland.

At Helsinfors the telephone system throughout is on metallic circuits with branching multiple switchboards and self-restoring drops, the equipment of the exchange having been provided by Messrs. L. M. Ericsson & Company. Both overhead and underground wires are employed. The number of subscribers on November 1 was 4,016. The subscription varies from 102 to 90 marks per annum, or (on a system of ownership of instruments by subscribers) the entrance fee is 150 marks and the subscription is 60 marks per annum. Females are employed exclusively as operators. The telephone staff, male and female, numbers 120 employés.

Theory of Induction Cores.

In the *Philosophical Magazine*, Lord Rayleigh discusses the common induction coil, and remarks that the ordinary theory of transformers is not applicable to such apparatus, since the primary circuit is not traversed by a continuously varying current. It turns out, indeed, that a closed magnetic circuit is unfavorable to a good length of spark. The core, moreover, should be fairly short, as with long cores the iron is saturated magnetically, and much of the energy of the primary current is wasted. Further, with a sufficiently rapid break a longer spark is obtained without a condenser than with it. Thus, with an Apps coil a longer spark was obtained without condenser when the circuit was broken by pistol bullet than when the break was made in ordinary way and a condenser was used. Results, however, depend upon strength of primary current, as the stronger this is the more rapid must the break be, if condenser is to be dispensed with. With each strength of primary current there is a particular capacity of condenser most suitable.

New Type of Arc Lamp.

Dr. Bang, the well-known Danish physician, has constructed a new electric lamp which is likely to prove of great importance, even outside the field for which he has intended it. In the ordinary arc lamp the carbons are heated to some 3,000 degrees, but Dr. Bang has succeeded in avoiding this high temperature by making the carbons hollow and letting a strong current of water run through them. The effect is very singular. Almost the whole of the energy of the electric current is removed to the light arc between the two electrodes, while the latter themselves remain so cool that one can touch them with one's fingers while the lamp is burning. In addition to this the carbons are consumed so slowly that the usual automatic adjustment can be dispensed with. In science the new lamp will no doubt be invaluable, says *Engineering;* its cold light is able to kill bacteria in one-eighteenth of the time required with the light of the ordinary arc lamp. The electrodes can be made from different substances, according to the use for which the lamp is intended. For medicinal purposes, carbon, silver and certain kinds of iron appear preferable. Metallic electrodes have been used for several years by doctors, but they have had many drawbacks; they gave a great heat, the metal melted, etc., and it was necessary to place the patient at a comparatively great distance from the lamp. All these objections have been overcome—or, rather, entirely removed—in Dr. Bang's lamp, which is very small and handy, and in which consumption of electricity is exceedingly small.

ELECTRICITY IN SOUTHERN COTTON MILLS.

BY GEORGE E. WALSH.

The southern cotton mill has become an important industrial factor in the cotton-growing states in the past ten years, and its rapid development has, to a certain extent, revolutionized the cotton-manufacturing industry of both the South and New England. The conditions of the South are so different from those of New England that it is not strange to find mill life and operation in the former totally different from the latter, and, at the same time, following somewhat divergent and entirely unique lines, practically accomplishing the same results. There is no accounting for the fact that for a century and more of active cotton-growing no attempt was made by the southern planters to establish mills near their homes to utilize the product of their soil, nor for the sudden interest in mill-building recently started in many of the cotton states. It is sufficient to note for the present purpose that the work has steadily broadened in the last few years until entirely new conditions are created in the disposal of the cotton crop.

The inducements to construct mills for manufacturing the cotton have increased in proportion to the number of those which proved successful earlier in the history of the movement, and last year proved the banner year of the whole industry, with more mills and spindles constructed than ever before. Plans for new mills, and the rehabilitation and enlargement of old plants, for the current year are even more promising of results than those of 1900. A good many of these new mills will be constructed on the instalment and cooperative plan. There has been no lack of capital seeking investment in southern cotton mills, but small growers of cotton have, in many instances, preferred to invest their own earnings in the home mills in preference to accepting outside capital. As a result there has been built up a profitable home investment industry that adds greatly to the success of the revolution. The operators in the new mills are for the most part drawn from the class of people who were known formerly as small farmers and field laborers.

The chief activity in building mills in the South has been in the South Atlantic and Gulf States, with a few scattering in the inland sections, and some as far west as the Indian Territory. Twenty years ago there were hardly a dozen well equipped cotton mills in the whole South. At the close of the century there were nearly 500 mills, representing more than 5,000,000 spindles. The actual growth of the mills began about ten years ago, and in the period extending between 1895 and 1898 the high-water mark of the development was reached. As an illustration of the rapidity of construction there were 325 mills in the South, representing 2,400,000 spindles, and in two years they had increased to 390 with 3,500,000 spindles, and since then the increase has been as momentous.

These mills represent all sorts and sizes, and a study of some of them will show the peculiar nature of the growth of the new industry. It has been only in recent years that the very finest modern mills have been erected, and it is in this period that the attempt has been made to economize in motive power. At first the economy was found in the cheaper salaries and wages paid to the employés, but such economy of mill operation is always questionable in the end. The true economy is found in cheapening the motive power and in a high grade of machinery. It is in these two latter directions that mill development in the South has been directed in the last five years. As a result some of the largest southern cotton mills are the finest and best equipped plants in the world, and the cost of running them is being slowly revolutionized by the introduction of electricity generated from water flow.

As most of the new mills are located along the line of rivers or water courses, the question of utilizing this water power in the best possible way has become the paramount issue. Gradually it is becoming known that the conversion of the water force into electric power for operating motors in various departments of the mills is the most satisfactory and economical way of taking advantage of natural conditions. At Columbia, S. C., a number of extensive cotton mills have motors operated in this way. A set of turbines supply the sources of power from a series of large dynamos. The different sections of the mills are operated independent of all others. In this way half, a quarter, or any fraction of the mill can be run while the rest is idle. The machinery is put up in sections in such a way that any part of it can be run or stopped without interfering with the rest.

This method of mill construction is now accepted as the best by nearly all the practical operators. The largest mill in the world—or, at least, the one with the greatest number of spindles under one roof—is the Pelzer Mill, located at Pelzer, S. C. The mill is run on the same plan, and the electricity is obtained from the power canal and distributed to the motors in the different departments. It has been found that this method ensures a considerable saving in the course of a year.

Electricity is the future power for the southern cotton mills, and no modern structures are erected to-day for any other power. Even when the mills must depend upon steam for their power it has been found that electric transmission makes a saving from twenty to thirty per cent. But most of the mills are located on streams where water power can be had in sufficient abundance to run the turbines. It is this natural advantage of the mills that promises to make the industry a continuously thriving and developing one.

With modern high-class machinery and electric power obtained from the flow of water, it is little wonder that the southern cotton mills have proved such profitable investments and that there is at present a remarkable boom in the work. The raw material of the cotton fields is near at hand, and it is harvested and carted to the mills, where it is quickly and easily converted into finished goods. Nearby is the seacoast, where ships are waiting to carry it to the distant countries and markets. So highly profitable have some of these mills proved that stockholders have had regular dividends declared from ten to thirty per cent. The latter dividend is extreme, but it has been declared on the capital stock of a number of the most fortunately located mills, while ten to twenty per cent dividends are quite common. These dividends are made only after allowances were deducted for wear and tear on machinery and the cost of installing new machines to keep the mills strictly up to date.

The original cost of one of these new southern cotton mills is a varying quantity, but approximately the average expenses incurred can be figured out from the data already supplied. The average amount needed for a mill is dependent upon the number of spindles planned. Lumber and work are both cheap in the South compared with the North, and good southern pine timber can be obtained nearby from mills which supply unlimited quantities. Hardware and machinery cost rather more than in the North, and other articles are at about the same proportionate price. With these conditions a mill with 3,000 to 4,500 spindles costs, on the average, from $70,000 to $75,000. Larger mills can be constructed at rather less proportionate expense, and it is the tendency now in most of the favored sections to build on a larger scale. Thus a $100,000 mill can be built with 5,000 to

6,000 spindles, and a $200,000 mill should easily represent some 15,000 spindles. The distinct gain in building on a large plan is further emphasized in the matter of operation. A large mill can economize in the matter of officers and employés, systematizing the work so that the greatest possible efficiency is obtained at the lowest price.

The number of operatives varies in proportion to the number of spindles, and there can be no saving in this respect in the large mills; but there is economy in the corps of officers, engineers and mechanics. The prices paid these officers in the southern cotton mills are not large, and are hardly consistent sometimes with the responsibilities which they assume. The salaries for the presidents range from $2,500 to $15,000 a year, the latter being paid to only a few of the executive heads of the mills representing from 75,000 to 100,000 spindles. Salaries for superintendents begin at $1,500 and rarely exceed $2,500. Assistant superintendents, secretaries and a few minor officers are paid salaries which sometimes, in the very large mills, reach $2,000 and $3,000, but generally range between $1,000 and $1,800.

The cost of motive power is one of the most important factors in the southern cotton mills, and it has been the means of revolutionizing the industry in the last few years by reason of many little methods of economy not thought possible before. The mills are all operated by steam or water, with the power transmitted in the form of electricity or direct. The cost of this varies somewhat, according to natural conditions. The cost of steam power, however, is more or less constant throughout the whole cotton belt. The average can be placed at $12.50 to $17.50 per horse-power per year. In the smaller mills wood is used to a very large extent for generating steam power, and so long as this can be gathered in the woods near-by, steam power can be supplied at the lowest figures. But this can not be for long. The mills are rapidly exhausting the lumber supply in their vicinity, and after that they will depend upon coal or water power. A few of the earlier mills were erected right in the midst of heavy lumber regions for the obvious purpose of utilizing this fuel for making steam, but to-day they are hopelessly stranded, away from coal or water power and with the woods nearly all cut down. Their usefulness is no longer considered within the range of the profitable, and in some instances they have been abandoned.

It takes about a cord and a half of the southern pine wood to generate the same amount of steam that a ton of coal will produce. In a cotton mill running from ten to eleven hours per day, six to eight tons of coal, or from nine to twelve cords of wood are sufficient to operate the 400-horse-power engine. Here we have in a few figures the practical cost of the operation of a southern cotton mill when run by steam.

When we come to water power the variation in the cost is far greater. It is placed anywhere from $7.50 to $15 per horse-power per year. This is where the power is applied directly to the operation of the machinery, and not when it is used for electrical transmission. The smallest cost is found in many localities where the mills have unobstructed use of strong currents which supply power enough to operate the whole mill the year round. The selection of a site with good water power is, consequently, one of the most important.

The ideal method of operating the mills is to use water power for generating electricity. This makes the cost from twenty to forty per cent cheaper than when the water power is used directly for operating the machinery, and from twenty to thirty per cent cheaper when the steam is used for electric transmission where no water power is convenient. This saving has been demonstrated in many cases in the South in the last few years, and the experience is sufficient to cause a general adoption of this form of power. Thus electric transmission from water power costs from $4 to $10 per horse-power per year. Everything depends upon the natural conditions and environments. At Gaffney, S. C., there is a large mill where the cost is computed to be at the lowest figure given, and another at Columbia, in the same state, has been run at an average cost of $5 per year.

There are innumerable streams of water scattered throughout the cotton belt which are eminently suited to the generation of electricity, and the work of building mills on the line of these is going on with great rapidity. The best sites are naturally selected first, and these have been largely taken up to-day. But the cotton belt is wide, and Texas, in particular, offers a wide field for this sort of development. The greatest difficulty is experienced in the summer time, when the streams dry up and lose much of their power for good. In some sections the water power becomes practically useless for several months in the year. Mills located in such places are usually built for the purpose of being run either by steam or water power. The engines are employed in the dry season to produce the electric power to operate the spindles and looms until the water power is restored in the natural way.

Views, News and Interviews.

The year just ended has been characterized by successful electric invention of a high order; the year just begun is full of promise. Electricians are a restless, alert class, and are never content to stand still.

The electric current has recently been put to a novel use—that of warming beds. The apparatus for this purpose consists of a coil of wire covered with asbestos. The electric current passes through this wire and heats up the asbestos. This method of heating would seem to be a great advance over that of using hot-water bottles.

Among the Parliamentary notices for the coming session are applications by the Central London Railway Company to make a circle of its present line, which would thus lie completely inside the now famous "Inner Circle," and a proposal to construct a circular underground electric line in Manchester. Besides the "tube" railways, held over from last session, there are a number of new proposals for London and in many of them, as well as in connection with some already authorized lines, Mr. Yerkes looms large.

A novel marriage ceremony took place recently. The parties to the contract were unable to be present at the same place and had to resort to extraordinary means. The bride stood in the telegraph office in Bowling Green, Ky., while the groom was in an office in Peaster, Tex. The questions were asked by telegraph from the Texas end by a justice of the peace, and answered by the lady in Bowling Green. This illustrates what difficulties it is possible for people to overcome when they have a certain object in view.

In the recent raids made by the police of New York city on some of the gambling headquarters, some very intricate electrical apparatus for warning the proprietors and patrons in case of a disturbance have been found. In some cases systems of electric wires have been installed which are said to have been as impassable as a Spanish trocha in Cuba. Push-buttons have been arranged at a number of different points in the entries for the purpose of giving instant warning. Wires have been connected with a mechanism for shutting off the gas by means of which the lights could be extinguished instantly in case of the appearance of the officers.

The London Telephone Service.*

In our last issue we published the Postmaster-General's statement regarding the London telephone service, with particulars of the various rates it is proposed to charge. In accordance with the views of the most recent Parliamentary Committee on Telephones, the basis of the Post Office charges is that known as the message rate. But the London telephone service hitherto has been charged for on the basis of a "flat rate," and the Post Office scheme provides for a continuance of this system for any subscriber who prefers it. There is some apparent complexity in the statement of the rates of charges, which may be more readily comprehended when it is understood that there are several Londons —the city of London, the county of London, and the London telephone area. These three Londons may be reduced to two—the county and the telephone area. On the message rate system, with a direct line, the "establishment" charge will be £5 per annum in the county and £4 per annum outside the county. For a two-party line the "establishment" charge will be £3 per annum for the whole telephone area. A ten-party line will be afforded to subscribers outside the county, and for this the establishment charge will be £2 per annum. No party lines will be permitted to subscribers connected with the central exchange in the city. Beyond the establishment charge, fees for each call will be paid, and these are: One penny for each call originating and terminating within the county, and twopence for a call originating in the county and terminating outside it. For a call originating outside the charge is one penny if terminating on the same exchange, and twopence if terminating on any other exchange. A subscriber will be required to guarantee a minimum number of messages or pay the value of them. Thus, in addition to the establishment charge there will be a minimum message charge of £1 10s. for direct lines and £3 for party lines. The minimum message charge added to the establishment charge will make the lowest payments (assuming the subscriber to be within two miles of the exchange) for the respective classes as follows:

Direct line in county	£6 10s.
Direct line outside county	5 10s.
Two-party line (city excepted).....	6 0s.
Ten-party line outside county.....	5 0s.

For these payments the subscriber on the direct line will be able to make 360 one-penny calls per year, or, say, one a day, and the party line subscriber two per day, if at one penny, but assuming that calls from outside the county will be mainly those terminating at some other exchange, and, therefore, chargeable at twopence, the number of calls permissible to a party line subscriber would accord with the direct line subscriber, and be one per day. Taking as a basis that 30s. per annum permits an average of one call per day, it will be seen that as soon as a direct line subscriber's calls amount to eight per day, the cost will be £17 per annum, and this is the amount charged to a subscriber who may make an unlimited number of calls. In the case of a second line the charge is reduced to £14. The call office fee is twopence per call within the area. There are additional charges of £1 5s. per quarter mile for any direct line subscriber whose premises are more than two miles from an exchange, and 10s. per quarter mile "for each subscriber where the main circuit of a party line exceeds two miles in length." Extension lines on the same premises will cost 30s. per annum if they do not exceed 110 yards in length, and 10s. extra for each 110 yards. Extension lines connecting separate premises, £3 10s. per annum within a quarter mile, and £1 5s. extra for each additional quarter mile.

The important statement that subscribers will have the right to communicate with subscribers of the National Telephone Company concludes the notice issued by the Postmaster-General, and in the explanatory remarks it is announced that the company has agreed to charge the same rates as the Post Office.

The announcement has necessarily been received with some criticism. It is urged in some quarters that the rates are higher than those foreshadowed when the new service was decided upon. Moreover, the term "competition," when prices are the same and the field of service identical, is not very intelligible to the man in the street. Thus, dissatisfaction finds expression in the idea that the intervention of the Post Office has not produced that amelioration in the telephone subscriber's lot which was fondly looked for. It is necessary to review the situation in order to realize just what it is that the Post Office has effected. When "competition" was determined upon, London (unlike the more favored provincial municipalities) had no provision for intercommunication between the "rival" services. The nominal rate for business premises in London has been £20 per annum, but on a five years' agreement this has been reduced to £17. For a private house £12 has been charged. Thus £12 per annum is the lowest sum for which telephone service could be obtained. This compares with £5 for the future, although the service is not comparable, since for the £12 unlimited calls on a direct line were permitted, while the £5 covers only one call per day on a ten-party line. In the Post Office scheme the private house unlimited service finds no place. The assumption would seem to be that, whether residence or business, the telephone used more than four and a half times per day is worth paying more than £12 for. It is in this way that the smaller user has been catered for in the message rate system. The chances of any such cheap service without Post Office intervention may be gathered from the statement on the subject in a recent report to the shareholders of the National company.

Instead of calling upon the unlimited user to enter into an agreement for five years at £17, the Post Office will connect up at that rate for one year only. Without further working experience, and having regard to the large growth which may be expected, it probably would be unwise to make a lower rate for unlimited communication over the London area. The avowed object of expected competition was to improve and cheapen the service. We are deprived of the competition in price, but the competition in quality is still available, though the opportunity of judging of such quality must be limited to connections on the individual services. We shall watch with interest the intercommunication of calls between the exchanges of different organizations. The right of intercommunication between the subscribers of a new exchange and the subscribers of an existing exchange is of considerable value to the new authority. Until the terms of agreement are published, we can not judge whether the price paid for the privilege is high or low. But so far as the public are concerned, it should be clearly understood that a comparison between the existing arrangement and a real competition without intercommunication would not be complete without assuming that a large proportion of the subscribers would need to pay two subscriptions. We can not, of course, regard the existing arrangement as more than another stepping stone toward consolidation under one authority. With its admirable system of mains and able engineering organization, the Post Office system ought to make rapid and steady progress, but it would be idle to deny that its prospects would be improved had the new arrangement caught the public sympathy.

The retirement of Mr. Forbes from the chairmanship of the National company, and his being succeeded by Sir Henry Fowler, will occasion no surprise. Public comments suggest that Mr. Forbes has completed his *magnum opus,* and that the occasion is a fitting one to choose. Mr. Forbes is full of years; he has steered his bark through troublous seas; his cheery optimism under apparently adverse conditions has been as a tonic to sufferers from depression; he has earned his leisure. It may be a matter for regret that he is chiefly recognized for his "astuteness." No one outside an organization can be in a position to know the ruling principles, but some there may be who might think that a recognition of the fact that telephone service is a matter of scientific engineering, might sometimes have avoided the necessity for the exercise of that "diplomatic engineering," in which Mr. Forbes is so generally recognized as a past-master.

* An editorial article from the London *Electrical Review.*

No Merger.

The daily press of New York announced on Wednesday of this week the probable merging of the interests of the General Electric and Westinghouse companies. An emphatic denial has been received by the ELECTRICAL REVIEW from official sources.

British Electrical Enterprise and Inventive Capacity.*

That electrical enterprise in this country is in many respects behind that of the United States and some parts of the Continent may be readily admitted, but it is distinctly untrue to attribute this backwardness, as the president of the Board of Trade did at the opening of the Croydon Electrical Tramways, to "this country being behindhand in inventive power," and we are surprised that Mr. Ritchie, with the knowledge which he has, or ought to possess, of the legislative hindrances that have handicapped electrical development in this country should have hazarded such an opinion. Even our keenest competitors recognize the baneful influence which parliamentary restrictions—operating, it may be remarked, largely through the medium of the department over which Mr. Ritchie presides—have imposed on engineering progress in this field, and which have resulted, as we all know, in many large contracts for electrical work being placed abroad; and we would commend to Mr. Ritchie's notice the following quotation from an article in a recent issue of an American electrical contemporary, which, dealing with this very subject, remarks as follows: "To us it seems clear that the cause of unreadiness recently displayed by English manufacturers to meet present home conditions in electrical developments is to be ascribed to the manner in which the electric light and railway industry in Great Britain has in the past been trammeled by governmental regulations and municipal dog-in-the-manger policy, which naturally has prevented manufacturing development. With our 3,000 central stations and 1,000 electric railways as a market, electrical manufacturing in this country (the United States) has happily been subjected to quite opposite conditions."

Natural conservatism may be a British characteristic responsible for a certain slowness of progress in new fields, but it is new to learn that Englishmen are "behindhand in inventive power," especially in matters electrical, considering the brilliant contributions to our stock of knowledge that have been made by English engineers and scientists. On the other hand, the English inventor has very real ground of complaint against the patent laws of his country, which are apparently designed only to rook him of fees and afford him little encouragement or protection.

* An editorial article in the *Mechanical Engineer*, Manchester, England.

Exposition at Lille, France.

Consul Atwell writes from Roubaix, that an international exposition will be held in Lille between the months of May and September, 1902. It will embrace the following classes: Instruction, works of art, liberal arts, general machinery, electricity, civil engineering, transportation, wheels, automobiles, sports, agriculture, horticulture, forestry, hunting, fishing, foodstuffs, mines and metallurgy, decoration, household furniture and accessories, yarns, dress goods, clothing, varied industries, chemicals, sound economy, hygiene, colonization, material and export products, special application of alcohol as a motive force and for lighting and heating. The office of the exposition is No. 35 rue National, Lille.

Ball Lightning.

Herr Tœpler suggests an explanation of the mysterious ball lightning, founded on some interesting experiments he has made on the discharge from a large multiple plate influence machine, says the London *Electrical Review*. When one of the electrodes of the machine is a metal point, and the other is a disc of some semi-conducting material, such as slate or basalt, an almost continuous discharge takes place, which appears at first as a glow, then, with increasing strength of current, becomes a tuft discharge, and a tuft arc light. If a metal ball, which may or may not be insulated, is held between the poles, the same phenomena show themselves on it as if it were an electrode—*i. e.*, tufts, etc., are formed on it. An aperture in a non-conductor, such as a plate of mica, behaves much the same as the metal ball, a mass of light being formed in the aperture when the plate is held between the electrodes of the machine. With sufficiently strong current a row of luminous masses, separated by non-luminous spaces, forms in the path of the current on each side of the plate of mica, just as if the current alternately expanded and contracted in section. Tœpler considers that these luminous masses may be produced by atmospheric discharges, and give rise to the appearance of ball lightning. Tœpler's experiments are described in the *Annalen d. Phys.*, vol. vi, p. 339.

The Cape-to-Cairo telegraph line has now been carried up to Ujyi, on Lake Tanganika. On reaching the north end of this lake, the line is to be taken easterly and along the shores of the Albert Nyanza, whence telegraphic communication with the coast already exists.

Elasticity of Copper Wire.

When different specimens of the same substance are used for determining elastic moduli, the results vary considerably, so that the values obtained for any one specimen describe the behavior of that specimen only, and do not hold universally for the substance in question. Determinations of the elastic moduli of metals are most often made on wires. It is, therefore, especially important to know how the elasticity of wires is affected by the processes used in their manufacture; of these drawing is the most important. In an article from the pen of Mr. J. R. Benton *(Physical Review)*, he gives the results of some experiments on the changes in elasticity which the process of drawing produces in copper wires. These are the principal facts that have come to light in the experiments. First of all, if a copper wire is first annealed by heating electrically to redness and is then drawn, its modulus of rigidity decreases, and Young's modulus increases. Also each successive drawing causes a further diminution of the modulus of rigidity, and a further increase of Young's modulus; for both moduli the amount of change becomes less with each drawing. Finally, if the wire is annealed after having been drawn several times, the modulus of rigidity returns to a value considerably greater than its original value, and Young's modulus to one considerably less than its original value. The author puts forward the theory that the difference in elastic properties between the wires annealed before drawing and those annealed after drawing, is due to the fact that the latter cool from red heat more rapidly on account of their smaller diameter, and are therefore more completely annealed. Referring to the change in Young's modulus, the author thinks this is not sufficiently great to account for the very considerable increase in resistance to bending, notwithstanding that drawn copper wires offer much greater resistance to bending than annealed ones. The author, therefore, determined Young's modulus for the same wires by the method of bending. Contrary to expectation, the values obtained by flexure were considerably less than those observed by extension. This would seem to indicate, though by no means prove, that Young's modulus increases more in the interior of the wires than near the surface. It is to be noticed that the values obtained by the two methods very nearly agree for the annealed wire. The greater stiffness of drawn wires as compared with annealed wires must then be due simply to the increase in the limit of elasticity. The flexural elasticity itself increases only slightly in drawing. The experiments from which the author obtained the above results were carried out in the physical laboratory, Princeton University.

Interest in Electrical Industries.

There appeared in the ELECTRICAL REVIEW of November 9 and December 14, 1901, reviews of the electric lighting and telephone industries, respectively. The articles were most widely read, to judge from the correspondence that has been received at this office, and from the discussion in the lay press that followed.

There is presented below a few out of the several thousand newspaper clippings that have reached this office, demonstrating the public interest in these young giant industries. In many instances the articles, giving capital and companies by states, were published in full by the leading state dailies.

"AMAZING GROWTH OF ELECTRIC LIGHTING."

[*Chicago Record-Herald.*]

Beyond any question the most marvelous development of the century in the field of applied science may be seen in the electric lighting industry. There is nothing comparable to it in the whole history of civilization. In nineteen years this industry has grown to where the investment in electric lighting plants in the United States alone now reaches the enormous sum of $700,000,000, according to a very careful tabulation made by the ELECTRICAL REVIEW, of New York. This extraordinary achievement represents a struggle with powerful and well-organized competition of a long-established industry—that of gas illumination. It made its way against bitter opposition, against corrupt councils and the difficulties and failures incident to over-capitalization to where it is now, one of the solid, certain and remunerative industries of the country.

According to the tabulation made by the REVIEW, Illinois heads the list in number of separate electric light stations, having 258, against 228 in Pennsylvania, 204 in New York and 188 in Ohio. Pennsylvania has the largest capitalization, however, her lighting plants being capitalized at a total of $110,008,000. New York comes next with $102,056,000; New Jersey, $64,429,000; California, $50,192,975; Massachusetts, $45,375,000; Illinois, $30,156,550.

SINCE THE CENTENNIAL.

[*Hartford Post.*]

The electric light was exhibited for the first time in the United States at the Centennial Exposition, but those who saw it were skeptical regarding the possibility of using it upon any scale that would be of practical benefit to mankind. While arc lighting was produced upon a commercial scale in 1877, the real history of the art, as regards its modern aspects, dates from the opening of the Pearl street station, in New York city, by Thomas A. Edison, on September 4, 1882, in which the Edison incandescent lamp was used. This industry has grown to where the investment in electric lighting plants in the United States alone now reaches the enormous sum of $700,000,000, according to the ELECTRICAL REVIEW, of New York.

NEW JERSEY THIRD IN CAPITAL INVESTED.

[*Newark Call.*]

In a recent number of the ELECTRICAL REVIEW figures were given regarding the electric lighting industry of the United States, the capital invested and the stations in use. In respect to capital invested in the industry New Jersey stands third among the states. . . . The table represents the maximum of information possible in the direction sought, and is complete up to September 1, 1901. The figures are the actual facts as regards the number of stations, but the total invested capital may be as much as ten per cent low, on account of the difficulty of obtaining from all the stations in the United States information concerning the amount of their outstanding securities. The number of stations given represent only those actually doing business.

TREMENDOUS INDUSTRIAL DEVELOPMENT.

[*Bridgeport Standard.*]

We never open the pages of the ELECTRICAL REVIEW without a thought of the tremendous development which it reflects and the ever changing, always increasing and perpetually wonderful phases of that development. There is nothing in history that is a parallel to it, for after the locomotive and the telegraph had been invented, the application of each was comparatively slow and the real greatness of both is a matter of recent years. But electrical adaptation and the immense industry that it has developed was much more rapid in growth and sprang fully armed and equipped from the brains which gave it birth.

In the New York ELECTRICAL REVIEW for December 14 there is an article showing the status of the telephone business in this country which is simply wonderful in its figures, and exhibits the phenomenal growth of that phase of electric service in a striking way. In all the telephone companies of the country, the REVIEW says, there are "4,311 exchanges in operation, with 2,278,717 telephones in use. The total capital invested is nearly $500,000,000. One company employs 33,000 persons and handles a total of 2,000,000,000 calls per year. The output of telephones in the manufactories is put by the REVIEW at a total of 3,000 a day, this annual product of instruments, with their accessory apparatus, being valued at between $50,000,000 and $60,000,000."

And all this in less than a quarter of a century! And the telephone is only one of the wonders of this development, although it involves so much.

"USE OF THE TELEPHONE."

[*Utica Herald.*]

The ELECTRICAL REVIEW, an authority on the matters with which it deals, says that there are now more than 2,278,000 telephones in use in the United States and that, at a very moderate estimate, they answer probably 5,000,000,000 calls during the year. The saving in time and labor implied by these figures is beyond calculation. Leaving out the millions of calls which are of a social nature and the other millions which might be dispensed with with small loss, the letter-writing, running of errands and the waste of time on fruitless journeys which the telephone renders needless can hardly be imagined.

"A GREAT INDUSTRY."

[*Buffalo Commercial.*]

There is much timely interest in the summary made by the ELECTRICAL REVIEW, New York, in its last issue, of the telephone business in the United States, which shows that, including all companies, there are 4,311 exchanges in operation, with 2,278,717 telephones in use. The total capital invested is nearly $500,000,000. One company employs 33,000 persons and handles a total of 2,000,000,000 calls per year. The manufacturing side, says the ELECTRICAL REVIEW, is estimated to produce a total of 3,000 telephones per day; this annual output of instruments, with their accessory apparatus, being valued at between $50,000,000 and $60,000,000. This is certainly a wonderful showing for an industry which, in the short space of twenty-two years, has come to be one of the most important in the country. It may be added that the authority quoted expresses the belief that the business is now entering on a new period of rapid growth.

"5,000,000,000 CALLS."

[*Cleveland Leader.*]

The ELECTRICAL REVIEW, a high authority, states that there are now more than 2,278,000 telephones in use in the United States. They serve for a yearly total of probably 5,000,000,000 calls, at a very moderate estimate. . . .

The progress of the world is many-sided, and its leaders are found in a great number of fields of endeavor, but the inventor and the scientific discoverer hold a high place among the very foremost benefactors of humanity.

THE TELEPHONE.

[*New York Times.*]

Of the magnitude of the telephone business at the end of the current year we have the following figures on the good authority of the ELECTRICAL REVIEW:

	Capital Invested.	Telephones Connected.
Bell	$320,000,000	1,080,000
Independent	150,000,000	708,717
Farmers' lines, intercommunicating systems, etc. (ind.)		490,000
Totals	$470,000,000	2,278,717

The best data obtainable as to the growth of independent companies, not controlled by the Bell, show that they now have exchanges in 2,811 cities and towns, and serve, as shown above, 708,717 subscribers.

Its strictly local utility is raised to the *n*-th power when a long-distance installation permits one to sit in his office or house and, at a cost less than the incidental expenses of a journey, not counting fares or

time, talk to Philadelphia or Chicago or Boston, and accomplish all he could have accomplished by going. This is an annihilation of time and space which would belong in the realm of magic if it was not a commonplace of daily experience.

The one ground for wonder which explanations do not explain is that the complicated and delicate mechanism of the human vocal organs is necessary to produce articulate sounds, if a vibrating disc of sheet iron in an instrument which never gets a sore throat or suffers from hoarseness can reproduce them so perfectly that the identification of a familiar voice is as easy as the identification of a photograph.

HALF A BILLION INVESTED.

[*New York Sun.*]

The ELECTRICAL REVIEW, in its current issue, contains a study of the present telephone situation in which it is shown that the amount invested in the telephone industry in the United States is nearly $500,000,000. This estimate includes both the lines and instruments of the American Telephone and Telegraph Company, generally called the Bell company, and of the opposition or independent companies.

All the states in the Union, with the exception of Nevada, Rhode Island and Utah, have opposition telephone exchanges, the total number of exchanges of this character being 2,811 and the number of telephones connected to them being 708,717. The largest extension of the independent telephone business is in the state of Ohio, which has 226 exchanges and 155,664 independent telephones.

The Bell interests have an invested capital of $320,000,000. These interests operate 1,500 exchanges, to which are connected 1,080,000 telephones.

During the last few years the United States Government has been installing a number of storage batteries for coast defense service. One of these is a Willard battery of sixty-four cells, installed in a casemate at Fort Perry, Plum Island, Ct. The elements of this battery are of 560-ampere-hour capacity and are placed in lead-lined tanks on racks and insulated with glass petticoat insulators. The batteries are used for lighting purposes, as well as for operating small motors in the various mechanisms employed in this service.

It is reported by the *Echo des Mines* that three electric furnaces of 500 horsepower each have been erected at Camonica, North Italy, for the manufacture of pig iron by the Stassano patent. The electrodes are placed at the bottom of the boshes. The ore and materials are analyzed, and the requisite quantities of each (carbon and lime or silica) are ground together, made into briquettes, with five to ten per cent of coal tar, and charged into the furnace.

"Ideal" Selective Party-Line Telephone Service.

The United States Electric Manufacturing Company, Butler, Pa., incorporated under the laws of the state of New Jersey, with a capital of $500,000, has purchased the patents of the Drake Telephone Company, covering the Drake selector and battery cutout, and has made various improvements on the system, on which patents are now pending. The officers of the company are J. W. Brown, president; M. A. Berkeimer, vice-president; C. A. Bailey, treasurer, and W. H. Miller, secretary, all prominent business men of Butler, and Fred E. Freers, superintendent, formerly superintendent of equipment of the Pittsburgh & Allegheny Telephone Company, Pittsburgh, Pa.

The company has established offices and a factory at Butler, Pa., and at present proposes to manufacture the "Ideal Selective Lock-Out Party-Line System" for exchange service, and the "Ideal Automatic Exchange System" for small towns, farmers' lines, factories, office buildings, hotels, etc., and, in fact, a system adapted for any kind of service which may be handled by an automatic exchange.

The selective lock-out party-line system can be applied to an exchange switchboard and operated in connection with it, and is especially adapted to farmers' lines, as any number of telephones up to thirty-five may be operated successfully on the same line. It claims the following advantages over the ordinary party-line system:

Any station on the line may be selected and called without calling any others on the line. This does away with a different signal for every telephone on the line, also the annoyance of ringing all parties on the line when calling any one. The system is also a lock-out system, as, while any two parties are talking, all other telephones are locked out, making it impossible to listen to or interfere in any way with the conversation. In case the line is busy, and a third party should wish to use the telephone, on removing the receiver from the hook a "line busy" signal is displayed, showing him why he can not

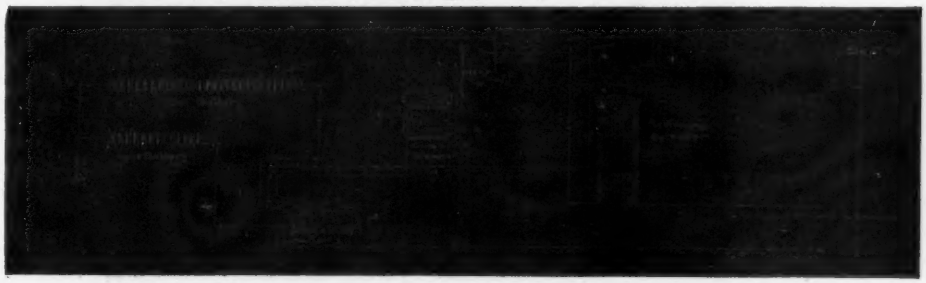


FIG. 1.—SHOWING LINE RELAYS.

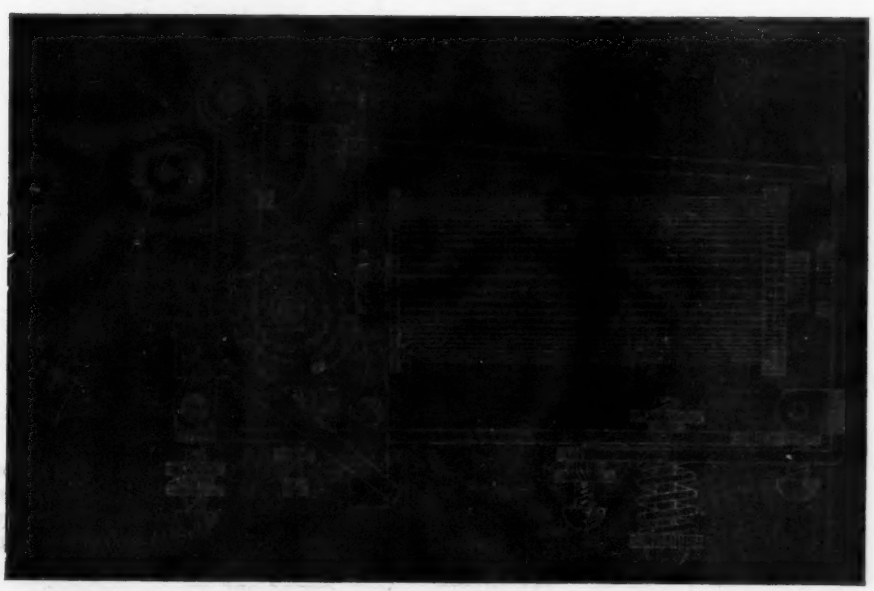


FIG. 2.—RESTORING SELECTOR.

use the telephone. The system practically enables an operating company to give independent service at party-line rates.

The automatic exchange system is entirely automatic, any party on the line thus throwing selector battery directly out on the line, and restoring the latter to its normal condition. The selector battery is opened automatically by the restoring selector, Fig. 2, which is operated as follows: It is stepped or revolved in unison

FIG. 3.—SELECTING KEY.

being able to connect himself with any other party, and talk privately, as, while talking, all others are locked out.

The telephone, Fig. 4, is neat and attractive in appearance, and is of the company's special design to accommodate the selector apparatus, which is mounted in the upper part of the telephone and serves to operate the indicator on the dial, and also to close the ringing and telephone circuits. The selector button is mounted directly below the dial, as shown in the cut. The transmitter is of a standard long-distance type, and the receiver is said to be of one of the most efficient bipolar types. The ringer, lock-out relay, generator and hook-switch are mounted in the lower part of the instrument and are all of standard material and up to date. The telephone operates as follows: To call, remove the receiver from the hook and then press the selector button, holding it down until the indicator is over the desired station number. Then ring the station in the ordinary manner.

By taking the receiver off the hook, Fig. 3, a wipe contact is made, grounding the tip of the line which pulls up the line relay, Fig. 1. This closes the selector battery through the circuit-breaker and also closes the telephone circuit at the relay, Fig. 3, which in turn holds the line relay up after the wipe contact is broken. The selector battery is now open at the selecting key, Fig. 3, which, when closed, immediately starts the circuit-breaker, which steps all the selectors on the line. When the station number desired is reached, as shown by the dial and indicator of the telephone, Fig. 4, the selector key is released and the party is called by the usual method. On hanging up the receiver the line battery is open, Fig. 3, and line relay drops back,

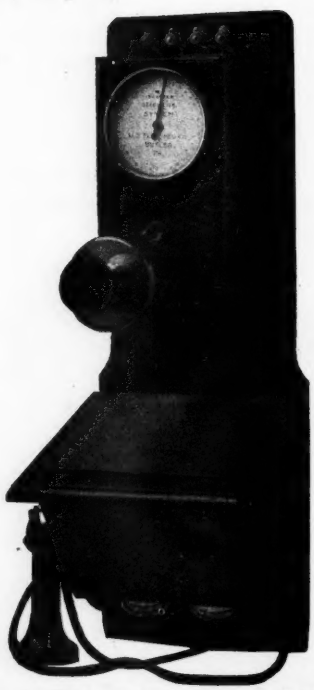


FIG. 4.—TELEPHONE SHOWING DIAL AND INDICATOR.

with all telephone selectors. When not in use the insulated point rests on the spring C, which opens the selector battery at that point. When a station is being selected the point I moves around and an electrical contact is made between the disc M and the spring C. When the restoring battery is thrown out on the line, the disc M is restored to its normal position, its motion being retarded by the escapement E for the purpose of giving the telephone selectors sufficient time to restore before the battery is cut off. The full selector circuit is as follows (see Fig. 1): The battery goes to the middle spring on the line relay; when relay is up, the battery goes through the top spring to the circuit-breaker, and through it to the line, where it is open until the selecting key, Fig. 3, is closed to select a station. When the line relay is dropped by hanging up receivers the selector battery then goes through the lower spring of line relay to the restoring selector, where it goes out on the line through the disc M and spring O, Fig. 2, and also through the coils of the restoring selector. When this is done the circuit-breaker is not in the circuit, which allows enough additional current to restore the selectors to their normal position; this can be seen by tracing the circuit through in Figs. 1, 2 and 3.

Fig. 5 is a view of the automatic device for operating a complete party line, or isolated system. It consists of a circuit-breaker, line relay and restoring selector. All parts are of polished and lacquered brass and is finished in the best possible manner, being mounted on a polished mahogany case and enclosed in a glass case. It is intended to be placed in an office and makes a neat appearance. Desk telephones will also be furnished with the system when desired.

The equipment will be ready in a very short time to be put on the market, as the factory is now in operation and the instruments are being assembled as rapidly as possible.

This system is claimed to fill a long-recognized need. In small towns, where only a limited number of telephones are needed, the system can be used to great advantage, as it does not require an exchange of any kind, thus saving the expense of rent, heat, light, operators, etc., and at the same time gives service both day and night.

FIG. 5.—AUTOMATIC DEVICE FOR WORKING A COMPLETE PARTY LINE.

A New Electrically Operated Railway Switch.

Labor-saving devices of many kinds have been introduced by the progressive managers of street railways since electric traction relegated the horse to obscurity. At crowded corners and switching points, however, the difficulty of maintaining a switchman, or else of stopping every car approaching the switch long enough to allow the motorman or conductor to set the switch properly, has long been encountered and has been productive of no little loss if its total effect upon the operation of such lines could be considered.

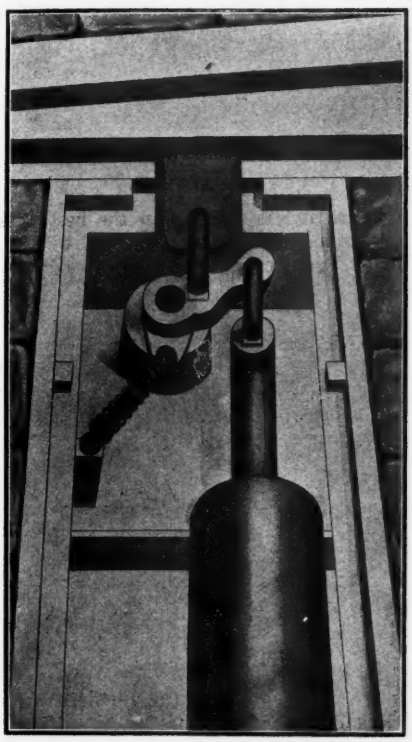


FIG. 1.—LINKS CONNECTING SWITCH TONGUE AND SOLENOID.

The interesting device illustrated in the accompanying engraving is an electrically actuated switch which may be operated by the approaching car without requiring it to stop at all.

In Fig. 1 is shown a portion of the electric switch device connected to the switch tongue, showing the tongue set for the straight track and the coil spring which holds it tight against either side to prevent cars shifting it as they pass over it. In Fig. 2 is shown the suspended arrangement whereby current from the trolley wire is shifted into the switch magnets as may be required. The circuit-changer is a solenoid encased in a box mounted on a convenient pole, and its operation may be seen from an inspection of Fig. 2. If the motorman approaching the switch desires to keep the straight track, he shuts off current so that when the trolley-wheel reaches the contact block it connects the two side strips of which this is formed,

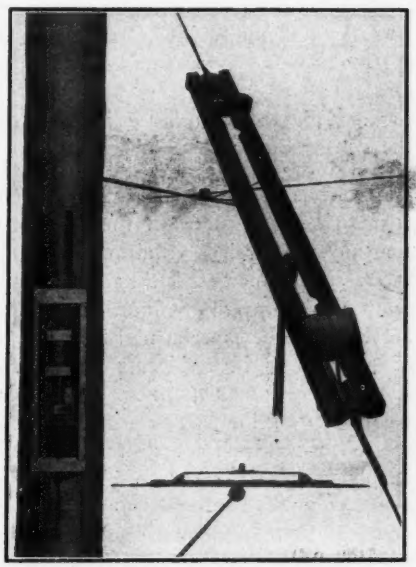


FIG. 2.—OVERHEAD SWITCH ON TROLLEY LINE.

allowing current from the trolley-wire to pass through the solenoid, causing it properly to connect the magnets in the switching arrangement to set the tongue

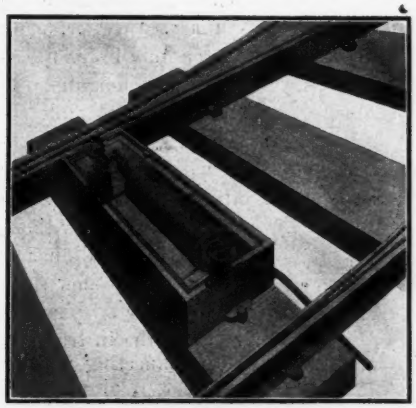


FIG. 3.—ELECTRIC SWITCHING MECHANISM IN PLACE BETWEEN TRACKS.

for the straight track. To set the tongue for the curve all that is necessary to do is for the motorman to keep current on while the trolley is passing under the overhead switching device shown in Fig. 2, when automatically the action of the solenoid brings the other magnet into play, setting the switch to pass the car around the curve.

In Fig. 3 is shown very completely the mechanism which is installed between the tracks for the operation of the switch tongue. The solenoid is solidly enclosed in a metallic water-tight cylinder, while most careful insulation is preserved throughout the entire device.

In Fig. 4 is shown a cross-section of the street box containing the solenoid and link connection with the switch tongue.

It is claimed by the makers of this interesting apparatus, the Cheatham Electric Switching Device Company, of Louisville, Ky., that a number of switches were placed where both wagon and car travel is heavy and the streets dirty, and in a climate where the winter temperatures went as low as twenty degrees below zero. After six years of service the devices are still operating with satisfaction, the only care necessary being that about every three weeks the iron lid must be taken off the street box in which the solenoid is set, and such mud as had accumulated scooped out. This is not necessary for cleaning the apparatus, but in order to prevent the mud getting into the link and lever arrangement connecting the solenoid and the switch tongue.

FIG. 4.—CROSS-SECTION OF ELECTRIC SWITCHING MECHANISM.

Metallic Nodules in Calcium Carbide.

MM. Guilbert and Dinan have recently analyzed some of those crystalline metallic nodules which occasionally are to be found in calcium carbide, and find them to consist mainly of iron and silicon, with small quantities of aluminum and carbon, and traces of manganese, calcium and magnesium, says our London namesake. A sample from the Arbine (Savoy) carbide factory gave Si, 28.60 per cent; and Fe, 66.30 per cent; one from the Giffe works gave Si, 25.95 per cent; and Fe, 65.26 per cent; one from Séchilienne gave Si, 18.60 per cent; and Fe, 75.29 per cent. A similar material discovered in Swedish carbide some time ago gave Si, 26.4 per cent; and Fe, 73.6 per cent; while Lewes has recorded a composition of Si, 30.76 per cent; and Fe, 58.06 per cent. The nodules evidently consist mainly of iron silicide; but it is clear that they do not form one simple chemical compound, part of the constituents being merely mixed together. Lewes has found nodules of two different kinds in some of the carbide he has examined; but Guilbert and Dinan apparently have noticed only one sort.

Chicago Electrical Notes.

(By Our Special Correspondent.)

THE city of Chicago is rapidly becoming the focus of an enormous system of rural trolleys. This system is destined to furnish wonderfully increased facilities for reaching the city from a territory radiating out nearly one hundred miles from it. Many of the lines are laid with heavy rails and ballasted, which permits them to use heavier and more comfortable cars and make much better time than has ordinarily been undertaken on most trolley lines. Being constructed in this manner they are able to take over many of the functions ordinarily performed by the steam roads, such as carrying the mails, newspapers and freight. The rapidity of communication between Chicago and these towns, and between the towns themselves, has been much increased by these lines, which permit business to be carried on much more rapidly and economically than before. The railways, in many cases, act as an important educational factor. The morning papers can now be read in places where it was formerly impossible to obtain them. The mail facilities have been much increased. The cars being right at the door lead many of the people to travel more and thus come in contact with their fellow mortals.

A novelty which a company of this city is exploiting is the apartment-house telephone system. After carefully studying the requirements of modern apartment-houses it was found that the speaking tube did not meet them, and the company therefore designed and brought out the apartment-house telephone system. Apartment entrance telephones are built in connection with letter-boxes, or without them, as may be desired, and are constructed either in wood or metal. Battery current is not started until the receiver is taken off the hook of the individual apartment called up. These apparatus are furnished with powerful microphone transmitters and a bipolar watch-case receiver with a hard rubber shell. The telephone connecting with it in the apartment proper is finished in wood of any desired kind, with a buzzer or vibrating bell. It is stated that the cost of such systems is comparable with that of the old speaking tube which it replaces. If desired, an especial apartment annunciator can be used in connection with the instruments mentioned above, thus permitting the janitor of an apartment-house practically to become an exchange operator and connect the various tenants of the apartments with one another. A large number of these systems are working in Chicago and other cities through the United States.

The demand for telephones in Chicago is beyond the resources of the telephone company, and it has withdrawn its canvassers. This increase is the result of the company's campaign of education, in connection with the experimental installation of party lines in residences and small stores. Of the 10,000 new subscribers secured during the past six months, 9,000 are persons who had never before used the telephone. It is hoped to increase the present number of instruments in the city (40,000) to 100,000 in two years, giving the city a larger number of telephone subscribers for its population than any other city in the world. President John I. Sabin, of the Chicago Telephone Company, has made a popular hit by installing movable telephones in fashionable restaurants. You do not have to leave the table to enjoy this luxury. "Waiter, bring me a telephone," is the only order necessary to have a fully equipped long-distance instrument at your elbow. By simply ordering a telephone a guest may be placed in communication with New York or Denver, or any other city served by the Chicago Telephone Company, without moving from the table at which dinner or luncheon is being served. The new service is very simple. When the telephone is ordered the waiter brings the instrument, inserting a plug with connecting wire in the spring-jack on the wall of the café, thus perfecting direct connection with the main telephone exchange.

The electric light company here is constantly enlarging. It seems almost impossible to keep up with the demand for light. Chicago deserves credit for its constant cry for "more light, more light."

We are taking much interest in the St. Louis Exposition. Chicago will be very largely represented by exhibitors, probably more extensively that any other city.

Chicago, December 28, 1901.

"Conigraph."

To the Editor of the Electrical Review:

Rather than "wireless telegraphy" why not "conigraph" and "conigram." Surely, Marconi should not be lost sight of in his flights through space.

Jarvis B. Edson.

New York, December 27, 1901.

French Automobile Show.

The preliminary arrangements for the fourth annual international show are being made by the organizing committee of the Automobile Club de France. The roads from Boulogne as far south as Dieppe are not as good as in England, but from Dieppe to London *via* Havre they are in excellent condition, and a 50-mile gait was easy and comfortable to take. One serious difficulty in driving over the French highways is in determining the proper direction at the junction of roads while running, from the fact that the guideposts bear signs upon which the lettering is so small that it is necessary to greatly reduce speed, and in many instances stop, in order to read them. Then, again, it is almost impossible, from entire absence of signs, without inquiry, to find your way through the villages; however, this difficulty is avoided in cities of which we are enabled to procure maps. It is not to be wondered at that so many dogs are killed, and sometimes children injured, by the automobiles, and it does not follow that fast driving is always the cause. It is customary in many of the cities and towns for the people to throw all their refuse into the streets, which during the day is gathered up by the city authorities. The dogs feed on this refuse and the children play with the dogs, hence both are in the streets a good portion of the time. Then, again, a dog runs out suddenly, barking at the vehicle, and, failing to gauge its speed, quite often falls a victim.

Sadness in London.

The winter session of the engineering and scientific societies is just opening, and presidential and inaugural addresses abound, writes the London correspondent of the Electrical Review. No less than six, all bearing the electrical outlook, in a certain sense, have been delivered in a week, and the remarkable thing about practically all of them is the sadness of their tone. The presidential address to the Institution of Electrical Engineers by Mr. Langdon is of a rather more cheerful nature, and Sir W. H. Preece, in proposing the vote of thanks, remarked upon this. He blamed the press for the gloomy opinions of those who relied upon the fourth estate for their information and maintained that we were not in a decadent condition by any means. Professor Perry, rather more flippant, said it was a characteristic of the Anglo-Saxon race to depreciate itself. But this only served to blind foreigners and really did us more good than harm. It is a fact that we Britishers, while being the first to moan over our troubles, if we have any, do not sit down to do the moaning. This latter is usually a prelude to something greater.

CURRENT ELECTRICAL NEWS

COMMERCIAL NEWS

DOMESTIC AND EXPORT

CIRCUSES WITHOUT HORSES—Mr. James A. Bailey, who has recently arrived from Europe, is said to have come for the purpose of making arrangements for a circus in which horses will be done away with and electrical apparatus substituted. The details of the plans have not been disclosed.

ERIE RAILROAD MAY CHANGE MOTIVE POWER—Superintendent Goldsborough, of the Allegheny Division of the Erie Railroad, is reported to have stated that the company is considering the matter of changing the motive power on the line from Dunkirk to Salamanca. It is said that a trolley system is the one most prominently considered.

ELECTRIC RAILWAY NEWS—The Everett-Moore Syndicate, which now controls lines extending from Ohio to Michigan, is said to have passed into the hands of the Vanderbilts. The lines of the Vanderbilt railways are now paralleled for a great distance by these electric lines. When this system is completed it is said that it will cover over 2,000 miles.

PACIFIC CABLE—Mr. George G. Ward, who is the vice-president and general manager of the Commercial Pacific Cable Company, is reported to have stated that legislation by Congress would not interfere with the construction of the Pacific cable, the work on which has already been begun. At the present time several bills for Pacific cables are before Congress.

CANADIAN POWER PLANT—Work will soon be started by the Vancouver Power Company, and the British Columbia Electric Railway Company is building a 5,000-horse-power electric plant which is to supply light and power to Vancouver, New Westminster and other places. This power plant is to cost about $700,000. The company has been granted a right to use 5,000 inches of water from Coquitlam and Trout lakes, on condition that it observes the rights of others who are interested in these waters.

ELECTRIC COMPANIES CONSOLIDATE—The Phœnix Gas and Electric Company is the name of a corporation which has recently acquired control of a number of electric companies near Phœnixville, Pa. Among these companies are the Consolidated Schuylkill Gas Company, the Schuylkill Valley Illuminating Company and the Montgomery & Chester Electric Railway Company. Mr. L. Knowles Perot is the president of this concern. It is planned by the new company to extend the facilities provided by the old companies.

GEORGIA ELECTRIC COMPANY—A petition for the incorporation of an organization to be known as the Georgia Railway and Electric Company has been filed in the office of the Secretary of State. The company is capitalized at $3,000,000. In this application are included rights of franchise on all the streets and roads in Fulton and DeKalb counties on which companies are at present operating. The charter would also provide the right to own and operate electric plants, and furnish electric power and steam heat. Those interested in the company are all from Atlanta.

WIRELESS TELEGRAPHY—The initial steps for adopting wireless telegraphy for the purpose of signaling between warships at sea have been taken by the United States Navy Department. Admiral Bradford, of the Bureau of Equipment, has asked that the armored cruisers of the Pennsylvania class shall be equipped with masts and rigging suitably arranged for the installation of the wireless telegraph system. For this purpose it will be necessary to lengthen the masts of the ships. It is said to be the intention of the Navy Department to get sets of different instruments of the various wireless telegraph systems and test them. Thus far no system has been adopted by the Navy Department.

ELECTRIC RAILWAYS

JENNINGS, LA.—A plan to build an electric car line from the oil fields to Jennings and Lake Arthur is being considered by capitalists. This car line would penetrate the heart of the oil and gas districts of Louisiana.

TRENTON, N. J.—Three trolley companies are now seeking to secure rights of way in Trenton. They are the Trenton Street Railway Company, the Camden & Trenton Traction Company and the New Jersey & Pennsylvania Traction Company.

BRAZIL, IND.—The construction of an electric line from Brazil to Jasonville is being agitated. Such a line would connect the Southern Indiana Railway with the Chicago & Southeastern Railway. The surveys for such a line are being carried on.

ROCKFORD, ILL.—A corporation known as the Aurora, DeKalb & Rockford Traction Company has been granted a charter to build a line from Aurora to Rockford. Messrs. H. W. Nichols, Jr., and C. C. Davis are among the incorporators of the company.

OKLAHOMA CITY, OKLA.—A number of gentlemen, among whom are Mr. Henry C. Garner and Mr. R. E. Richardson, of Kansas City, have applied to the city council for a franchise to operate an electric railway in Oklahoma City. It is expected that the franchise will be granted.

BELTON, TEX.—Nearly all the rights of way for the Belton & Temple Electric Railroad have been secured. It is said that the work of surveying the line will soon be begun. It is planned by this company to install an electric lighting system and a telephone system as well as build the railway.

STROUDSBURG, PA.—A company has received a charter to build a trolley line from Stroudsburg through the Water Gap to Portland. A survey has also been filed for a trolley line between Phillipsburg and Washington. Such lines would compete for the local traffic of the Delaware & Lackawanna Railway.

JEFFERSONVILLE, IND.—It has been announced that the building of an electric line to connect Indianapolis, New Albany and Jeffersonville will be begun about March 1 by a large force of men. Such a railway would connect at Seymour with the line which nows runs from Indianapolis to Franklin.

TORONTO, ONTARIO—The work on its new extension to Schomberg is being rapidly pushed by the Metropolitan Railway. The work has been more than half completed already and men are working night and day at present. It is planned to handle a large amount of freight in the way of farm produce upon this extension.

CLEVELAND, OHIO—The men who are preparing to bid for the twenty-year franchise offered in the ordinance which was introduced into the council by Mr. Frederic Howe have laid out two complete street railway lines across the city. It is not yet understood what was the purpose of introducing this ordinance into the council.

GREENSBURG, IND.—The city council has granted a franchise to the Shelbyville, Greensburg & Batesville Traction Company to use the streets for a period of fifty years. In this franchise it is specified that the railway shall carry freight as well as passengers and that the city is to receive $15,000 from the company for the privileges granted.

PITTSBURGH, PA.—A partial list of the officers who will have charge of the traction lines under the new company after January 1, has been announced by Mr. J. D. Callery, who is to be the president of the Philadelphia Traction Company. Mr. James H. Reed will be the vice-president, and Mr. S. LaRue Tone assistant to the president. A number of superintendents have been appointed to have charge of a considerable part of the lines. There will also be division superintendents under them.

ELIZABETH, N. J.—The papers of incorporation have been filed by a large traction company which has an authorized capital stock of $1,000,000. Among the incorporators are Governor Voorhees and Judge Benjamin A. Vail. Mr. Frank Bergen has been elected president of the company. It is planned to run a trolley line along Staten Island sound from Elizabethport to Cartaret, Warren and Boynton Beach. From Cartaret it is probable that the line will be extended to Woodbridge and Rahway, and from there to Elizabeth.

BALTIMORE, MD.—It is said that the work of constructing railways between Baltimore and Washington and Baltimore and Frederick city, will be begun in the spring. The Laurel & Burwyn Railway Company has been incorporated to construct a line between Burwyn and Laurel, which connects at Burwyn with the City & Suburban Railway operating between Washington and Burwyn. A number of Cleveland capitalists are to construct the lines from Laurel to Baltimore, and also a branch to Annapolis, Md.

TELEPHONE AND TELEGRAPH

LOCKPORT, N. Y.—The contract for a large building to be used for a telephone exchange will soon be let by the Bell Telephone Company.

ALBION, MICH.—The city council has been asked to grant a franchise to the People's Telephone Company for a term of thirty years.

LOMETA, TEX.—A telephone line from Lometa to Bend has been finished by Mr. F. W. Dent. A line is soon to be built from Bend to Chapel.

KALAMAZOO, MICH.—J. B. Ware, manager of the People's Telephone Company, Detroit, and Mr. D. L. Berry, of Jackson, have asked for a franchise in Kalamazoo for an independent telephone company.

ST. PAUL, MINN.—An amendment to its articles of incorporation, which increases its capital stock to $150,000, and its limit of indebtedness to $100,000, has been filed by the Southern Minnesota Telephone Company.

DELAND, FLA.—Work is to be begun shortly in installing its system by the Peninsular Telephone Company, which was recently granted a charter. The company has made preparations to complete its system as soon as possible.

RALEIGH, N. C.—A large number of improvements in its system are being made by the Interstate Telephone Company. A considerable amount of modern apparatus is to be installed by this company and the service greatly improved.

HOMESTEAD, PA.—It has been announced by the Central District and Printing Telegraph Company that it will expend about $50,000 for a new telephone exchange in Homestead. The system of the company is to be overhauled and improved.

KNOXVILLE, TENN.—A large amount of money is to be spent in improving its service by the East Tennessee Telephone Company. Among the improvements are a large switchboard and a considerable amount of new cable which will be installed throughout the city.

BARTOW, FLA.—The city council has granted a franchise to the Southern Bell Telephone and Telegraph Company. When the system of this company has been constructed it will give two long-distance lines to the city, as the Peninsular Telephone Company also has a franchise.

BUFFALO, N. Y.—It has been stated that the Frontier Telephone Company will accept the franchise which has recently been granted by the city and that the work of installing the system will be begun as soon as the contracts are let. Buffalo should be well supplied with telephones judging from the companies given franchises there.

PARIS, KY.—Messrs. Odell and Jones, the manager and superintendent, respectively, of the Fayette Home Telephone Company, have been in Paris examining the streets and making plans for the erection of a telephone exchange. It is said that plans and specifications are to be made ready immediately and the construction material ordered.

BOSTON, MASS.—The new telephone company which is to be formed to take over the Erie telephone properties will start off January 1 with 162,500 telephone subscribers, distributed as follows: Arkansas, 48,000; Cleveland, Ohio, 14,500; Minnesota and the Dakotas, 24,000; Michigan, 52,000, and Wisconsin, 24,000. The estimated gross income for 1902 is placed as high as $6,500,000.

TRENTON, N. J.—Congressman H. C. Loudenslager, who is the head of the Interstate Telephone Company, is said to be negotiating for the Independent Camden Telephone System. It is said that an exchange building to cost about $100,000 will be erected by the Interstate Telephone Company in Camden. This company is now engaged in constructing a line between Atlantic City and Camden and expects to have a line across New Jersey connecting with New York and Pennsylvania in the near future.

AUTOMOBILE NOTES

NEW AUTOMOBILE COMPANY—A new automobile company, which is to be known as the Fournier-Searchmont Automobile Company, has been incorporated with a capital stock of $2,000,000. This company is to be located at Saratoga Springs, N. Y., and will manufacture motor cars, wagons, carriages and other vehicles.

MR. A. L. RIKER, First Vice-president Byllesby, Chief Engineer Whiting and Chief Constructor Sammis, of the Riker Motor Vehicle Company, have handed in their resignations, to take effect January 1. The principal patents of this company are held by Mr. Riker, and it is reported that a new company will soon be organized, with probable headquarters at Elizabethport, N. J.

LEGAL NOTES

RIGHTS OF A MUNICIPALITY—The extension of the limits of a municipality over a road on which street railway tracks have been laid under authority of the county is held, in Westport *vs.* Mulholland (Mo.) 53 L. R. A. 442, to subject such road to an ordinance forbidding the tearing up of streets without consent of the municipal authorities; and no contract between the county and the railway company is thereby impaired, where the ordinance merely requires the tearing up of streets to be under reasonable police regulations.

LIABILITY OF A RAILWAY COMPANY—A railroad company is held, in Baker *vs.* Louisville & N. Terminal Company (Tenn.) 53 L. R. A. 474, not to be liable to an employé of an ice company who was injured by falling from the top of a car which he was storing with ice, either because the car was left on a curve which caused it to incline sideways, or because the roof was slippery with ice, since these were not defects in the premises, the duty to remedy which the railroad company owed to persons impliedly invited to its premises.

ELECTRIC LIGHTING

ST. JOSEPH, MICH.—The municipal electric light plant has now been completed and light from it is being furnished to the city.

PARIS, TEX.—The charter of the Paris Light and Power Company has been amended by increasing its capital stock from $120,000 to $200,000.

MARSHFIELD, VT.—The building for the power-house has been completed by C. I. Preston & Son, and it is now ready to receive the machinery. Water power will be used.

MARSHFIELD, VT.—An electric light and power plant is being installed at Molly's Falls. This plant is to furnish light and power for the towns of Marshfield, Plainfield and Cabot.

CANNON FALLS, ME.—Messrs. Peters and Kilroy have purchased the electric light plant from Mr. D. Valentine. The plant is to be overhauled completely and improved throughout.

AUBURN, N. Y.—Mr. James E. Gibson, who represents the National Gas and Construction Company, of Philadelphia, has been awarded the contract for constructing the Citizens' Light and Power Plant.

MILWAUKEE, WIS.—The capital stock of the Farmers Telephone Construction Company, of Milwaukee, Wis., has been reduced from $500,000 to $250,000. Messrs. Frank Bigelow and E. A. Wadhams are interested in this company.

MARINETTE, MICH.—Mr. L. J. White is preparing to secure a franchise from the Marinette city council for a new electric lighting plant. He has stated that from $30,000 to $75,000 will be spent in the installation of a new lighting system.

INDIANAPOLIS, IND.—A number of merchants have organized a company which is to petition the Board of Works for a light and power franchise. It is said that it is the intention of the company to construct its own lighting plant.

HALLOWELL, ME.—The Kennebec Light and Heat Company is constructing a line for the transmission of power from Hallowell to the Bodwell Quarry. It is the intention of the quarry company to do away with steam power and use electric power in the future.

LUDINGTON, MICH.—The power-house of the Pere Marquette Railway Company is to be closed. A contract has been made by the company with the Stearns Light and Power Company to light the docks and yards and furnish power for operating the elevator.

BETHLEHEM, PA.—The Bethlehem Electric Light Company suffered very severe loss from the effects of the water in the recent storm. The generators were rendered useless for the time being. At present the light is being supplied by the Allentown Light Company. It is announced that the plant will be rebuilt on a site where it will be impossible to suffer damage from water.

ELECTRICAL SECURITIES

The week closed with a firm market. An increase in the surplus reserve of the New York Clearing House banks of $2,106,025, which figures ran ahead of expectations, was mainly responsible for a strong and higher stock market. There were, also, a higher market for Americans at London, a favorable Northern Pacific exhibit for November, a disposition to regard conditions in the sugar trade as on the mend and anticipation of early improvement in the monetary situation. There was a lull in speculation soon after the opening on Saturday last, with a moderate reaction in prices, but the market became active in the last half hour of trading, and speculation became animated.

The banks now hold $7,891,350 in excess of legal requirements, with the prospect of a further gain in the early future. The last bank statement of the year is always interesting in the light of comparison with that of years immediately preceding. The reserve shown last Saturday compares with a surplus in the corresponding week of last year of $11,525,900. It is believed that the banks of the country have larger cash resources than ever before.

During the week Amalgamated Copper not only held its own in the trading, but recovered sharply from its low level, notwithstanding the general dissemination of information concerning existing conditions in the trade which were responsible for its decreased dividends. The recovery in the price of the stock took place also notwithstanding intimations that further reductions in the selling prices of the metal might be looked for. The stock appears to have lost its weakening influence upon the remainder of the market.

ELECTRICAL SECURITIES FOR THE WEEK ENDING DECEMBER 21.

New York:	Closing.
Brooklyn R. T.	65⅛
Con. Gas	216
Gen. Elec	283
Man. El	137¾
Met. St. Ry	162
Kings Co. Elec	185
N. Y. & N. J. Tel. Co	166
Telep., Tel. & Cbl. Co	6½

General Electric Company has declared a regular semi-annual dividend of 3½ per cent on preferred stock, payable January 31, to stock record January 15. All the preferred stock has been exchanged for common, except 98 shares outstanding, and less than half a million of the debentures.

MR. CHARLES W. MORSE is reported as saying: "I am not in a position to express an opinion on the reorganization plans of the Erie Telegraph and Telephone Company. It can not be authoritatively stated that I have either disposed of my stock in that company or have given an option on my stock. I will acknowledge, however, that I am now considering certain offers which involve my telephone interests." Mr. Morse recently purchased the control of the Telephone, Telegraph and Cable Company, of New York, of which Judge J. M. Thomas is the executive head.

The New York & New Jersey Telephone Company has declared a quarterly dividend of 1½ per cent and an extra dividend of 1 per cent, payable January 15. Mr. W. D. Sargent, the vice-president and general manager of this ably conducted company, is also a director in the National City Bank of Brooklyn, the leading bank of that city.

Philadelphia, December 21:	Closing.
Elec. Co. of America	6
Philadelphia Elec	4½
Union Traction	32½
United G. I. Co	117
Elec. Stor. Bat. c	63
Elec. Stor. Bat. pf	63

It is announced that the Rapid Transit franchises in Philadelphia have been transferred to the Union Traction interests. One of the conditions is believed to be that there shall be no tracks on Broad street and another condition provides for the financing of the Keystone Telephone Company's opposition to the Bell company.

Chicago, December 21:	Closing.
Central Union Tel	40
Chicago Edison Light	160
Chicago Telep	223
Metropolitan El	90½
National Carbon	19¼
National Carbon pf	83¼
Union Traction	10½
Union Traction pf	47½

Chicago Telephone shares broke from 230 to 218 on Monday, later advancing to 223. This decline practically wipes out all the advance the stock had recently on the announcement of the rights to be issued to stockholders during the coming year. The price moved up to 240 on the news at first.

Boston, December 21:	Closing.
Am. Telep. & Tel	163
Erie Tel	17
New Eng. Tel	133
Mass. Elec. pf	94
Westing Mfg. pf	91
Edison Elec. (rights)	3½

Details of the plan for the reorganization of the Erie Telegraph and Telephone Company, involving a transfer of its control to the American Telephone and Telegraph Company, were made public in a circular to the Erie company's shareholders. The plan provides for a new company to be capitalized at $16,000,000 of 6 per cent cumulative preferred stock. After two years $16,000,000 of common stock and $10,000,000 of 5 per cent thirty-year gold bonds will be issued. $6,000,000 in cash is to be provided for the operation of subsidiary companies. The American Telephone and Telegraph Company is to purchase a majority of the shares of the two classes of stock, and out of the money received from this the $9,000,000 of notes will be paid off, in January, 1902, and $6,000,000 in cash provided. In an interview, Mr. Chas. J. Glidden, former president of the company, favors the plan, stating floating debt represents new construction during 1900 and 1901. The Boston *News Bureau* says: "The strong feature of the Erie Telephone reorganization is that the company in effect converts $9,000,000 of floating indebtedness into a 6 per cent preferred stock, and raises $6,000,000 of new money for development and extensions."

It is understood that Messrs. Kidder, Peabody & Company have purchased $10,000,000 American Telephone and Telegraph 4 per cent bonds which will probably be issued for public subscription during this month.

PERSONAL MENTION

MR. WILLIAM A. ROSENBAUM, patent attorney, has removed his offices from the Times Building to the Nassau-Beekman Building, corner of Nassau and Beekman streets, New York city.

MR. A. C. WHITE, general manager of the Providence Telephone Company, was a New York visitor last week, having recently recovered from a severe illness. Mr. White remembered several of his electrical friends at Christmas, with the bird that is Rhode Island's most popular product.

PROFESSOR R. B. OWENS, of McGill University, of Montreal, is visiting New York and Baltimore on a holiday vacation. Professor Owens has the honor of presiding over one of the finest electrical engineering departments in any educational institution in America.

MR. E. B. PICKHARDT, who at one time was associated with the advertising department of the ELECTRICAL REVIEW, is western manager of the Eclipse Company, with an office at 303 Dearborn street, Chicago, Ill. Mr. Pickhardt's new field of activity will undoubtedly bring good results to the interests he represents.

MR. BEECHER OGDEN has accepted a position with the American School of Correspondence, of Boston, to act in the capacity of managing the publication department. Mr. Ogden is well known throughout the publishing world as having been manager for a similar department for the International Correspondence Schools of Scranton, Pa.

MR. FRANCK Z. MAGUIRE, of Maguire & Baucus, Limited, London, is visiting New York, with headquarters at the Hotel Imperial. Mr. Maguire is very enthusiastic over the new Crawford-Voelker incandescent lamp recently described by him in the London *Electrical Review*, and states that it is attracting much attention in electrical circles of England and the continent of Europe.

DR. S. S. WHEELER, of the Crocker-Wheeler Company, of Ampere, N. J., was the recipient of a suitably inscribed silver loving cup the day before Christmas, presented to him by the heads of the departments of his company. Mr. H. L. Patterson presented the beautiful gift at the rooms of the C W Lunch Club—which Dr. Wheeler had been instrumental in successfully organizing—and his pleasant remarks completely surprised the recipient.

HON. HENRY C. PAYNE, of Milwaukee, Wis., who has been selected by President Roosevelt as his new Postmaster-General, is well known in the electrical field. He was at one time president of the Wisconsin Telephone Company and vice-president of the Milwaukee Electric Railway and Light Company, and was president for one term of the American Street Railway Association. Mr. Payne is a forceful, energetic and popular gentleman and will undoubtedly be a most valuable member of President Roosevelt's cabinet.

INDUSTRIAL ITEMS

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., is said to have received a large contract for equipping the trolley system of Tokio, Japan. The contract is stated to amount to $750,000.

N. W. AYER & SON, Philadelphia, Pa., newspaper advertising agents, have issued a very neat and attractive calendar for 1902. The figures used for the dates are large and should make it a useful addition to any office.

THE ELECTRIC APPLIANCE COMPANY, Chicago, states that there are eighty-five thousand A-B arc lamps in use in the United States, and that they are all giving satisfaction. This company keeps these lamps in stock.

THE C. W. HUNT COMPANY, of New York, has issued a leaflet containing an interesting description of an electric coal hoisting plant for discharging vessels in New York Harbor. This plant is equipped with the Hunt electric hoist and automatic railway. Some very interesting facts and figures relating to the plant are given.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY, of Cincinnati, Ohio, has been awarded the contract for two 3,200-kilowatt generators by the Cincinnati Gas and Electric Company. The Allis-Chalmers Company received the contract for two 3,750-horse-power engines. The amount of money involved in these contracts is about $200,000.

W. C. STERLING & SON, of Monroe, Mich., have received the contract for 1,500 white cedar telephone poles from the Telephone Company of Egypt, Limited, which operates a large telephone system there. These poles are to be shipped to Alexandria and Cairo. They are at present negotiating for the shipment of a large order of poles to Spain and Portugal.

A LARGE PLANER—What is said to be the largest motor-driven planer ever built by the Pond Tool Works, of Plainfield, N. J., is now under course of construction. At its completion it will be shipped to the Farrell Foundry Company, of Ansonia, Ct. The length of the planer bed will be sixty-four feet, in three sections, and its entire weight when erected will be about 100 tons.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, Mo., states that it is having an unusually large demand for its K. P. fuseless rosette. This rosette is said to be especially adapted for 250-volt currents, and is made so that the strain of the cord does not come on any connection, which greatly strengthens it. This rosette is made in one solid piece of glazed porcelain and is easy to connect.

THE SOUTHERN INDUSTRIAL PUBLISHING COMPANY issued a handsome Christmas edition of *Dixie*, and calls attention in an interesting way to the industrial development of the South, particularly during the past year, an advancement which probably far excels that of any previous year. *Dixie* is a highly creditable publication and the ELECTRICAL REVIEW congratulates it over its very comprehensive Christmas number.

SCHLESINGER & MEARS, St. Paul Building, New York, a company which was established some months ago as special manufacturers' agents, reports its business as rapidly growing and that it has been especially successful with its "S. & M." incandescent lamp. The company handles rubber-covered and water-proof wire, cables, special porcelain products for the electrical trade, and many specialties that go to make up the line of general electrical supplies.

THE CUTTER COMPANY, Nineteenth and Hamilton streets, Philadelphia, and 120 Liberty street, New York city, on January 1 assumed the entire management of the sales of the Keystone electrical instruments. A number of important changes and improvements have recently been made in this well-known line of instruments and users (among them some of the best engineers in the country) report them to be entirely satisfactory. Under the well-directed management of the Cutter Company the sales should show a very large increase during the coming year. The manufacture of the Keystone instruments and all electrical and mechanical details will, as heretofore, be under the direct management of Mr. J. Franklin Stevens. The Cutter Company will be glad to send catalogues and literature and to make quotations upon request.

THE CROCKER-WHEELER COMPANY, of Ampere, N. J., has just completed an exceedingly prosperous year. It reports a record-breaking midwinter business, and finds it difficult to keep the production up to the demand. The following are some of the recent shipments: Two 400-kilowatt generators to the Vandegrift Construction Company; one 300-kilowatt generator to Stetson & Company, of Philadelphia; one 150-kilowatt generator to the D'Olier Engineering Company, of West Camp, N. Y., and one 40-kilowatt generator and twenty-eight motors to the Smith-Brooks Publishing Company's plant in Denver, Col. The United States Tube Company, of Buffalo, N. Y., has been supplied with a motor equipment, and the electrical equipment of the Con. P. Curran printing establishment in St. Louis, Mo., which takes the place of line shafting, has been completed. Orders for a large number of motors have been received from Armour & Company, the American Bridge Company, and the Marion Steam Shovel Company. An order for a thirty-kilowatt special generator has been received from H. H. the Sultan of Linga. The machine is to be installed in the royal palace, which is on an island near Singapore.

NEW INCORPORATIONS

CHICAGO, ILL.—Automatic Electric Company. $2,000,000. Incorporators: Edwin W. Gearhart, James C. Law and others.

CONCORD, N. H.—The Franconia Electric Company. $250,000. To manufacture and to engage in the general electrical business.

WOLF CITY, TEX.—Wolf City Electric Light and Power Company. $10,000. Incorporators: C. R. Seltzer, W. R. Seltzer and others.

NEW YORK, N. Y.—Universal Steam Power Company. $100,000. Directors: W. J. Foster, M. Seabury and W. B. Overton, of New York city.

EL RENO, OKLA.—El Reno Plumbing and Electrical Supply Company. $3,000. Charter to run five years. Directors: M. F. Pettee, F. B. Johnson and others.

NEW YORK, N. Y.—Stratton Motor Company. $150,000. Directors: E. F. Stratton and David Wood, of New York city, and G. H. Murray, Jr., of Hollis, L. I.

NEW YORK, N. Y.—American Diesel Engine Company. $2,500,000. Directors: A. L. Curtiss, D. W. Morrow, Harold Walker and others, of New York city, and J. Clinton Walker, of Brooklyn, N. Y.

UPPER SANDUSKY, OHIO—The Tiffin & Southern Electric Railway. $500,000. To operate an electric railway line from Tiffin through Upper Sandusky to Kenton. Incorporators: Michael Riley, of Pittsburgh; Judge Smalley, of Upper Sandusky, and others.

LIMA, OHIO—The Western Ohio Railway has increased its capital stock from $1,000,000 to $3,000,000. This company has secured the right to construct an electric line from Wapakoneta to Shelby, from St. Marys to Celina and from Celina to a point on the west line of Mercer County.

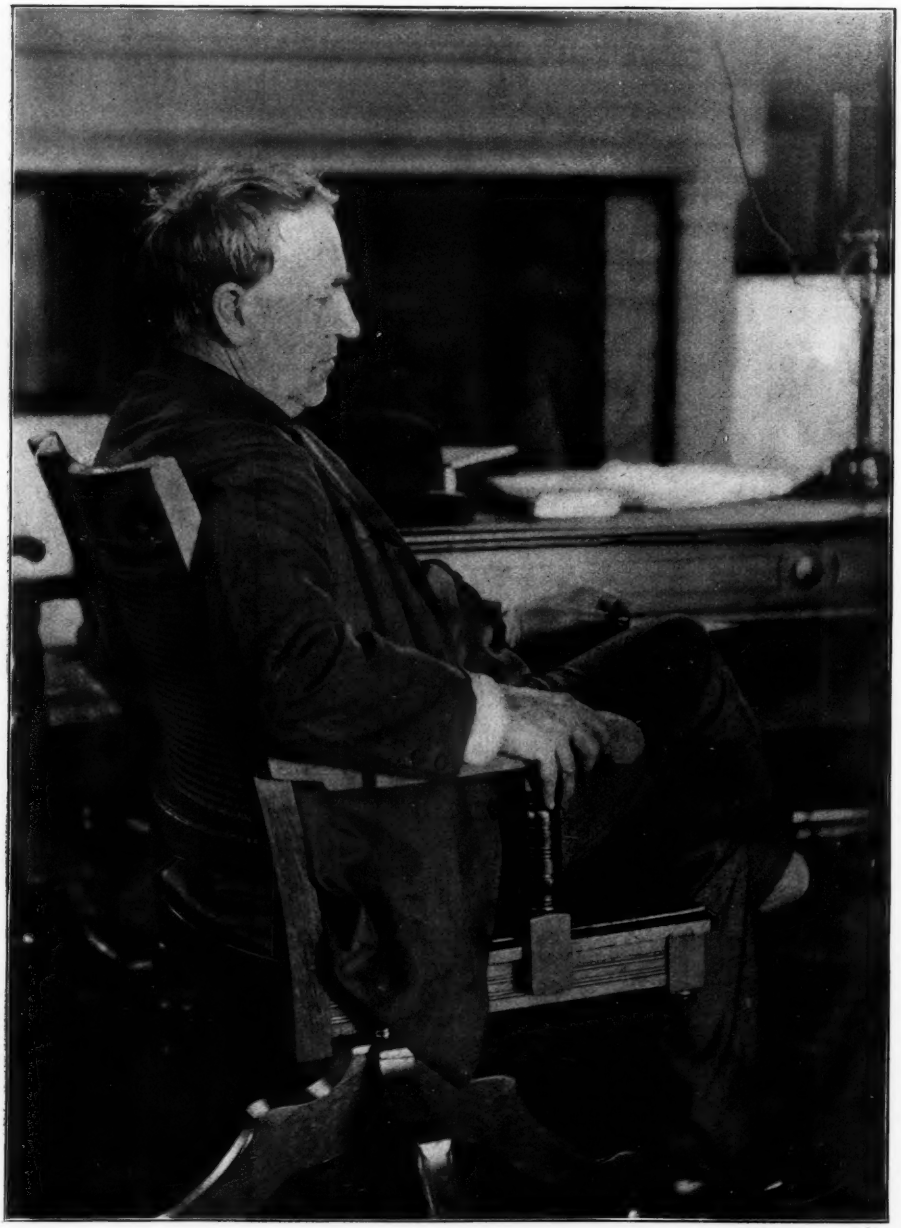
SYRACUSE, N. Y.—Syracuse Lighting Company. Increased its capital stock from $2,500,000 to $4,000,000. Before this change the capital consisted of $1,500,000 common stock and $1,000,000 preferred stock. The increased capital consists of $3,000,000 common stock and $1,000,000 preferred stock.

HYRUM, UTAH—The Union Electric Light and Power Company. $40,000, divided into 4,000 shares of the par value of $10 each, 1,020 shares of stock have been subscribed. Mr. John F. Wright is president of the company, Mr. Joseph Howell is vice-president, and Mr. G. F. Wright secretary and treasurer.

TARENTUM, PA.—Tarentum-Leechburg Traction Company. $85,000. It is the purpose of the company to construct an electric street railway from Tarentum to Freeport through Allegheny township to Leechburg. Mr. Richard D. Scandrett, of Pittsburgh, is president of the company, Dr. S. J. McMains, of Leechburg, secretary, and Mr. George B. Friedly, of Freeport, treasurer.

GEORGETOWN, OHIO—The Ripley, Georgetown, Hillsborough & Columbus Railway Company. $10,000. In shares of $100 each. It is proposed to construct and operate an electric line from Ripley to Columbus, passing through the counties of Brown, Highland, Fayette, Pickaway, Madison and Franklin, and touching Georgetown, Sardinia and Hillsborough. Incorporators: M. McKeehan, G. Baumbach and others.

SHEBOYGAN, WIS.—The Wisconsin Railway and Electric Company. $100,000. To build and operate a street and interurban railway through and between the village of Sheboygan Falls and the city of Plymouth, and other points in Sheboygan County. It is the intention of the company to carry on its line passengers, baggage, mail, express and freight. Incorporators: George B. Mattoon, J. Donahue and others.



THOMAS ALVA EDISON

Photographed especially for the ELECTRICAL REVIEW, during a moment of rest in the library at Mr. Edison's Laboratory in Orange, N. J.
Photograph by Vander Weyde.